Engineering Library

# Engineering News

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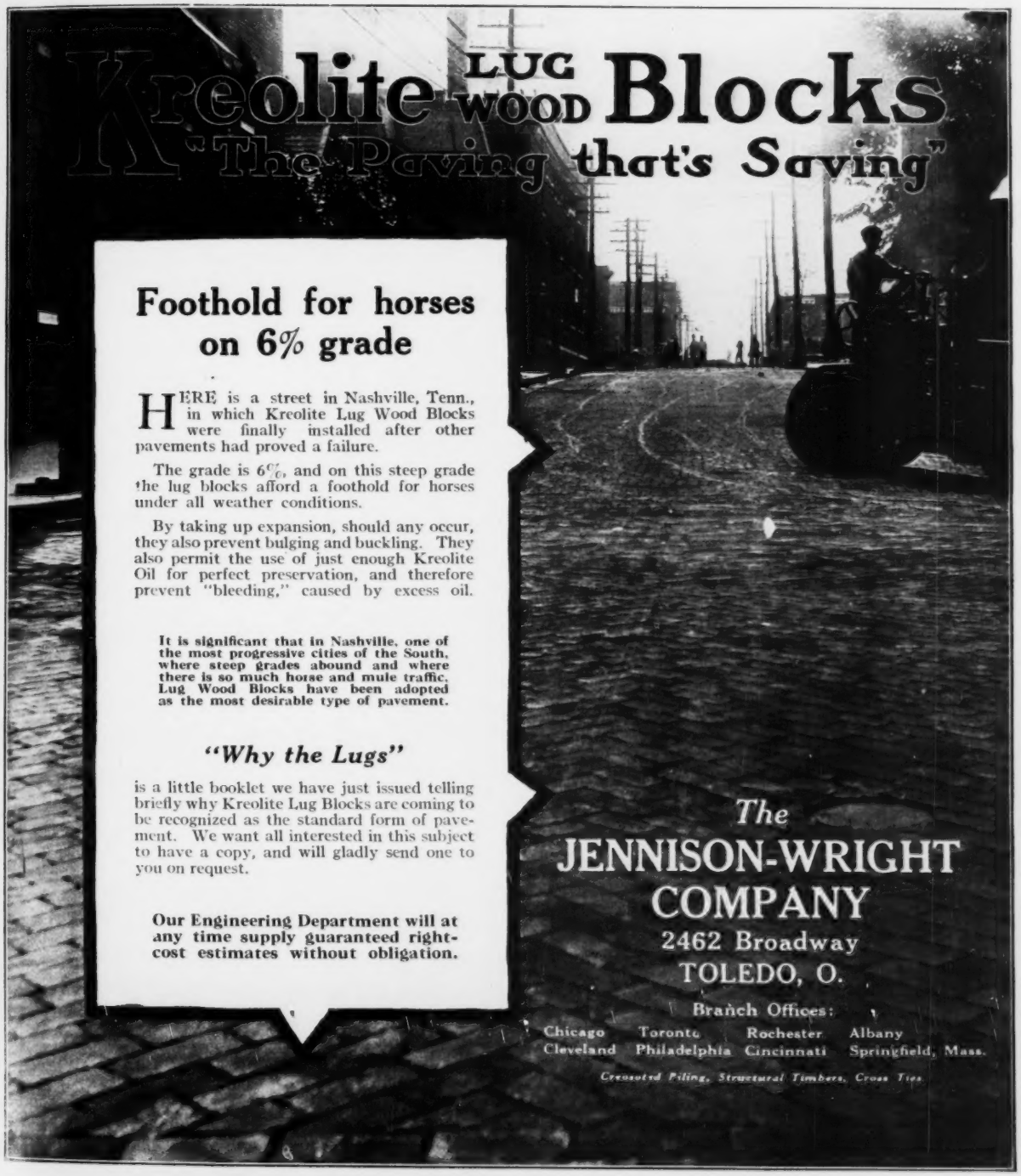
Kreolite LUG WOOD Blocks
"The Paving that's Saving"
Foothold for horses on 6% grade
HERE is a street in Nashville, Tenn., in which Kreolite Lug Wood Blocks were finally installed after other pavements had proved a failure.
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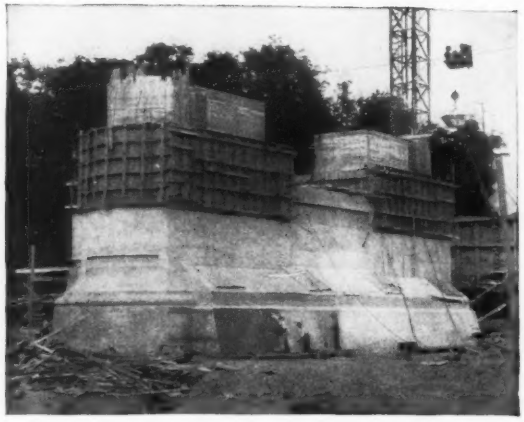
# Lackawanna Steel Sheet Piling Cofferdams for Pier Footings of the Bloor Street Viaduct, Toronto

The Bloor Street Viaduct, Toronto, Canada, will provide a direct route from a section of the city somewhat isolated by two deep ravines, and is in many respects comparable to the well-known Tunkhannock Viaduct on the Lackawanna Railroad.

The longest section, extends for 1,680 feet across the Don Valley and includes a bridge 1,077 feet long and 130 feet above the Don River. Of the seven bridge piers, four are about 125 feet high and rest on 40 by 80-ft. foundations that reach to solid rock at depths of 33, 48, 37 and 44 feet respectively below the ground surfaces.



The Lackawanna Steel Sheet Piling cofferdam, in which one of these pier footings has been built is pictured here while the steel sheet piling was being driven. This sheet piling was in 30 to 40-foot lengths and had to penetrate loam, sand, flowing sand, gravel, boulders and boulder clay which was very hard. We are told by the contractors, Quinlan & Robertson, Ltd., Montreal, that some of this Lackawanna Steel Sheet Piling was taken from another job where previously it had been used *six times*, then it was used three times on this job in different cofferdams and finally was returned to storage for still further use.

Lackawanna Steel Sheet Piling is now considered by many prominent contractors as stock equipment, and when so used enables its owners to cut costs and get work which might otherwise be out of reach.

Get our literature, and, if you want it, the free advice of our steel sheet piling engineers.

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Engineering News

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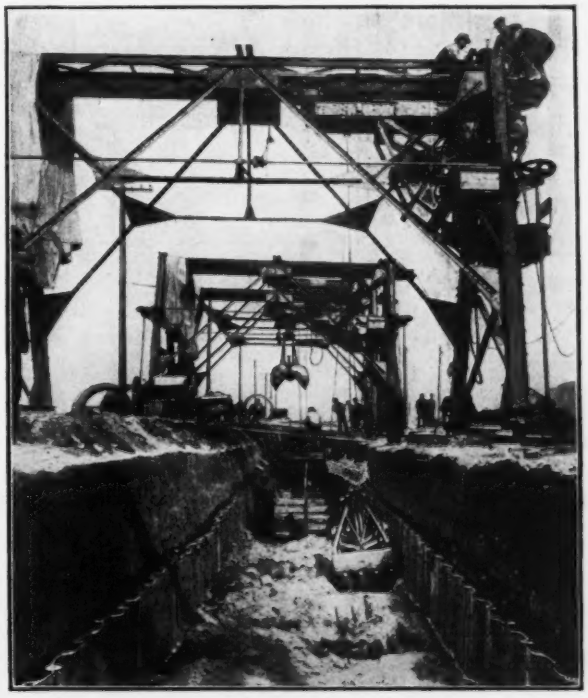
# Gantry Cranes Work on Sewer at Salt Lake City

The new intercepting sewer about completed at Salt Lake City, Utah, will form an outlet for all that portion of the sewerage system not tributary to the gravity sewer system. It begins at 10th South and 7th West streets, connecting there with the 60-in. main sewer, draining approximately 68 mi. of sewer recently constructed. It runs thence northerly a total distance of 23,850 ft. to the intersection of 9th North and 11th West streets. This line is located in the western part of the city at practically the lowest ground level, and will be deep enough to take care of the sewage from any portion of the city. The sewer is being built of lock-joint reinforced-concrete pipe made by the Pacific Lock Joint Pipe Co., under an agreement with the contractors, Messrs. Gibbons Bros., Reed & Roche. The grade of the sewer varies from 0.104 to 0.45%. The depth of the trench varies from 14.6 to 19.9 ft., with an average depth of 17.1 ft. The material encountered consists of alternate layers of clay and sand. The ground-water level is approximately 7 ft. below the surface. The contract amounts to $296,510. The lengths of pipe of each size and unit prices are as follows: 700 ft. of 30-in. pipe, $2.35 per lin.ft.; 2,437 ft. of 42-in., $3.73; 6,628 ft. of 60-in., $5.10; 8,838 ft. of 66-in., $6.50; 3,556 ft. of 72-in., $8; 1,692 ft. of 78-in. $10 per lin.ft. The unit price for excavation and backfilling was $0.97. The trench width for the 78-in. pipe averages 10 ft. 8 in. The pipe was made at the rate of approximately 60 ft. per day for each size.



EXCAVATING AND SHEETING SEWER TRENCH 10½ FT. WIDE, SALT LAKE CITY, UTAH

Gantry in foreground digging with clamshell, next one in rear digging in strutted trench with orange-peel. Rear gantry engaged in setting concrete pipe

Lackawanna steel sheetpiling was driven by a pneumatic hammer for each side of the trench. The first 6 or 8 ft. of excavation was taken out with teams and the remainder handled by clamshell and orange-peel buckets operated electrically and working from the gantry cranes shown in the view on this page. A separate gantry crane was used for handling the pipe and for pulling the sheetpiling. The material taken out of the trench was hauled back by dump carts along the line of the sewer and used for backfilling.

Three gantry cranes of the same general structural framing were employed. The first one went right behind the preliminary hand excavation and, with clamshell, made the next cut. Behind this the trench was strutted and the excavation made to grade with an orange-peel working from the second gantry between the struts. In the rear a third gantry lowered the reinforced-concrete pipe units to place.

The gantry cranes are framed of battered bents just above the rails on which they run, connected by a cross-frame which carries the electric motor and the transverse track on which runs in one case the buckets and in the other case the tongs for the pipe. The tracks are regulation rails laid, one on each side the trench, on short ties. The bucket cranes are provided with one 30-hp. and one 14½-hp. motor for the hoist and one 6½-hp. motor for the drive, while the pipe crane has a 15-hp. motor for the trolley and a 6½-hp. motor for the drive. These machines were made by the Sprague Electric Works of the General Electric Co. They are fairly common in coal handling practice but are novel for trenching machines.

A pumping plant will be installed at the lower end of this sewer to discharge the sewage into a gravity line, whence it will be carried to Great Salt Lake. Completion of these sewerage improvements will provide, in connection with the gravity outlet sewer, sufficient outlet capacity for a population of 500,000. The contract for the work was let Aug. 5, 1915, the time for completion being 200 days. The work is under the direction of Sylvester Q. Cannon, City Engineer, Salt Lake City.

# Largest Dredging Caisson Sunk as Building Foundation

*SYNOPSIS—An enormous open dredging well, or caisson, has been sunk during the past winter in Bear Lake, 100 mi. northeast of Salt Lake City, and in it are now being constructed the foundation and substructure of a pumping station of the Utah Power and Light Co. The purpose and design of this plant were presented in "Engineering News," July 13.*

The location chosen for the Lifton pumping station is on a causeway separating the north end of the lake basin—now a separate sheet of water called Mud Lake—from Bear Lake itself. This beach is all very fine sand, considered a quicksand; borings to considerable depth, made by the owners preliminary to design, did not find the bottom of the sand stratum.

The type of foundation chosen was a pile group capped with a concrete mat or slab at the depth required by the pump intake—about 40 ft. below water level. The problem was to make the excavation, drive the piles, place the capping slab, and then build the concrete substructure of the pumping station, with its inlet and discharge passages formed in the concrete. The dredging-caisson method was adopted as the simplest and surest way of accomplishing these results.

The design of the caisson is shown in Fig. 1. The structure, 140 ft. long, 62½ ft. wide and 45 ft. high, is a shell of 12-in. timbers stiffened by series of interior struts in both directions at about 11 ft. spacing horizontally, and 2 to 4 ft. clear spacing vertically. This describes approximately the lower section or first build-up, which is the part of the caisson designed to resist the sinking stresses. The coffer-dam or second build-up, erected above when the first build-up had started sinking, consists of 3-in.

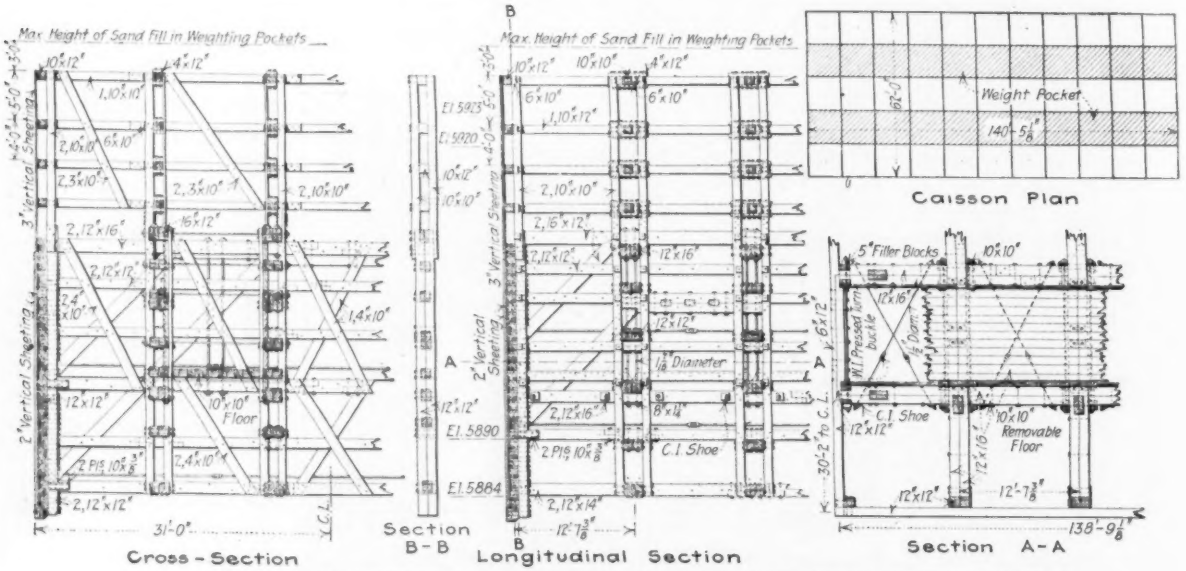



FIG. 1. FRAMING OF DREDGING CAISSON FOR FOUNDATION OF LIFTON PUMPING STATION

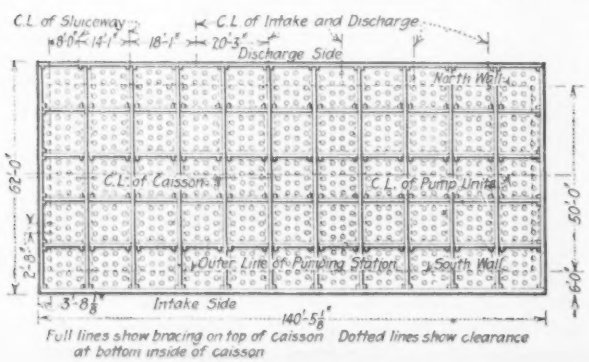

C.L. of Sluiceway
C.L. of Intake and Discharge
Discharge Side
North Wall
C.L. of Caisson
C.L. of Pump Units
Outer Line of Pumping Station
South Wall
Intake Side
Full lines show bracing on top of caisson at bottom inside of caisson
Dotted lines show clearance

FIG. 2. PILE PLAN

sheeting on frame-ribs with interior bracing similar to that below but of larger vertical spacing.

Arrangements to secure sinking weight and transfer this to the working-chamber shell complicate the simple structure somewhat. The 55 pockets (five lines of 11 each) formed by the interior strutting were in part used as sinking-weight pockets. The middle and the two outer lines of eleven pockets were left open for excavation and the two intermediate lines were sheeted inside and filled with earth to load the structure down and sink it. To transmit the weight of this loading to the outer shell, a full set of diagonal batter posts and horizontal tie-rods was built into the framing, as shown in Fig. 1. These elements in effect formed series of Howe trusses across the width of the caisson, supplemented by queenpost trussing in the longitudinal direction.

The caisson contains about 800,000 ft. of timber, and 120 tons of rods and fastenings. All material had to be teamed in 12 mi. from the nearest railway station (Paris, Idaho). Timber was stacked in a large material yard arranged at one end of the site and was cut and framed in a carpenter's yard near the caisson site. Four derricks

set alongside the caisson, two on each long side, placed the timber. Separate working drawings or cutting sheets were made for the individual sticks of the timberwork, so that the carpenters were relieved of all work in interpreting the general drawings and determining the dimensions and cuts. This uncommon procedure proved highly successful after the first start, and worked out to complete satisfaction.

### Sinking the Caisson; Marsh Gas Outflow

It was the intention originally to sink the caisson by dredging, in accordance with normal practice. The sand was counted on to flow sufficiently to enable buckets in the three rows of open compartments to clear the ground under the weight pockets, since it was known that when disturbed and mixed with water this sand takes very flat slopes. However, the material in place was found to be an extremely solid mass, compacted and dried out by lying undisturbed for a long time. Neither clamshell nor orangepeel buckets would bite in sufficiently to let the work progress at a reasonable rate. In fact, the material was so tight that the seepage into the caisson was negligible, even at its lowest level. Hand shoveling was resorted to, and the material was hoisted out by skips.

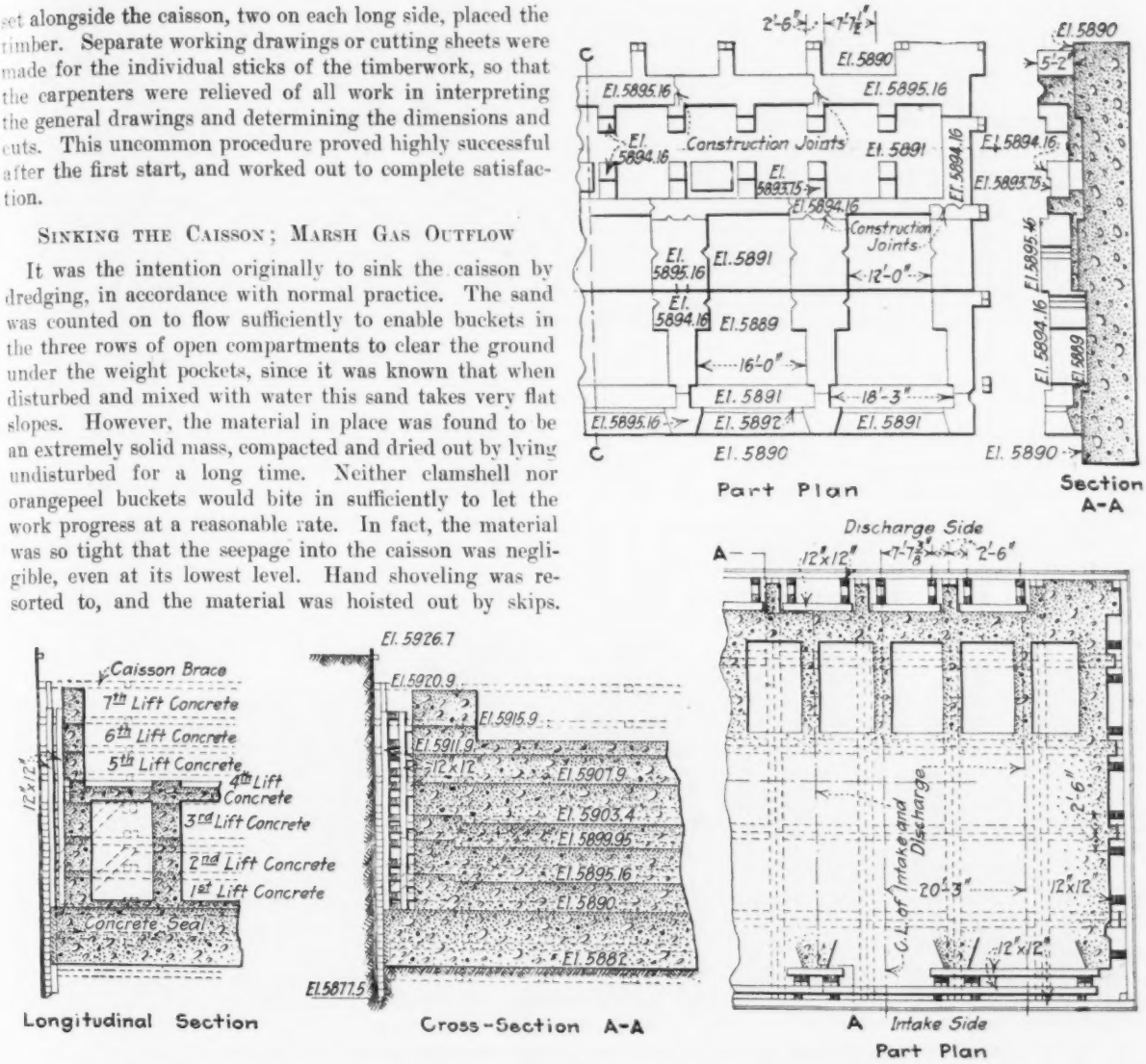



FIG. 3. SECTIONS SHOWING ARRANGEMENT OF CONCRETING WITHIN CAISSON

The sand being such that it became of running character when disturbed and under the influence of moving water, the sinking created a belt of disorganized sand all around the shell of the caisson. The frictional drag of the caisson as it went down and the downward seepage of water along the shell of the caisson made the material unstable. This caused a certain amount of trouble, with some runs or blows that were just short of being dangerous. The wide cutting edge of the caisson (see Fig. 1) required the excavation to undercut this edge almost completely. Conditions were thus created that favored sudden blowing in of quantities of sand. Even without such movement there was a continuous flow of sand downward along the side and into the caisson as the sinking progressed. This disturbed the surface immediately adjacent to the caisson. The pile towers supporting the derricks were in one or two cases put out of business by subsidences from this source.

More serious difficulty was caused by outflows of marsh gas from the soil in the caisson. The gas was always present, but for long periods it blew out under pressure and the aggregate of gas flow was of enormous volume. Occasionally the jets of gas were lighted and they would then flame up four or five feet high in a steady geyser.

Beyond the difficulties just mentioned, the caisson sinking proceeded smoothly and uneventfully. It was started on Feb. 19, 1916, and the caisson reached its final elevation, about 46½ ft. below ground, on Apr. 6. The maximum rate of excavation was 1,000 cu.yd. a day. In the working time mentioned, a week was taken out for putting on the second lift. The theoretical amount of caisson excavation was 13,000 cu.yd. Actually about 17,000 cu.yd. was excavated.

### Pile Foundations

The caisson is only a temporary device, a means of making the excavation and constructing the foundation, not a load-carrying element. The weight is carried by a pile group spaced at practically minimum spacing all over the caisson bottom.

It proved to be impossible to drive piles on account of the hard condition of the sand already referred to. All

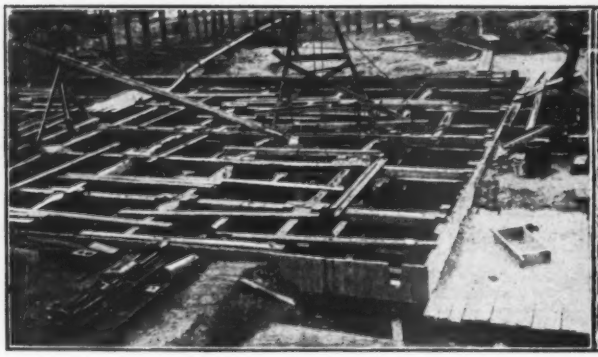


FIG. 5. CAISSONS SUNK TO BOTTOM
Top of cofferdam showing. Chute in place for concreting middle line of pockets

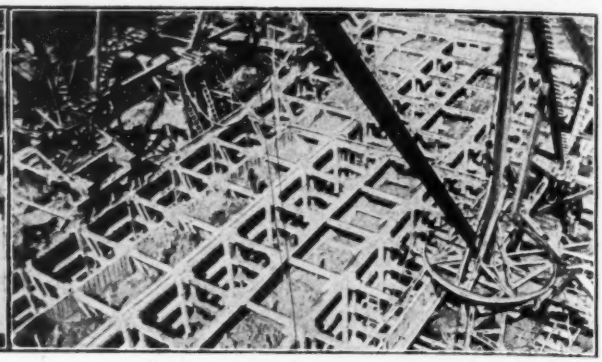


FIG. 6. CAISSON DURING SINKING
Top view showing dirt in weight pocket and other three lines of pockets open for dredging

of them had to be jetted down. A penetration of 35 ft. below caisson bottom was decided upon as satisfactory and the originally ordered 65-ft. piles were cut off after driving.

During this jetting operation the sand rose up 4 ft. within the bottom of the caisson. This was essentially inflow from along the sides of the caisson under the cutting edge. About 2 ft. of this material was blown out by a sand ejector after the pile work was completed.

The concrete pile-cap or seal course, a slab approximately 8 ft. thick engaging the upper 3 or 4 ft. of the piles, was deposited in a continuous operation, the work extending over some two weeks. The bottom of the caisson at this time, as previously, was practically dry. During the work gas had to be taken care of by piping through the seal concrete, the pipes being plugged subsequently.

### Concreting Arrangements

Sand and gravel suitable for concrete had to be brought from a point about 3½ mi. away. Here a dragline excavator was set up which dug the material and loaded it on cars to bring it to the site. At the site it was washed and screened and then dropped into storage bins holding about one day's supply.

Below the bins were mounted two mixers, only one being needed—the other as reserve in case of breakdown, in order not to interrupt the concreting. Sand and gravel were supplied to the mixer hoppers by a measuring car running past the bin spout and discharging directly into the hopper, while cement was brought from the cement storehouse alongside the bin structure. The mixers discharged into the hopper of a hoisting tower 110 ft. high alongside one end of the caisson.

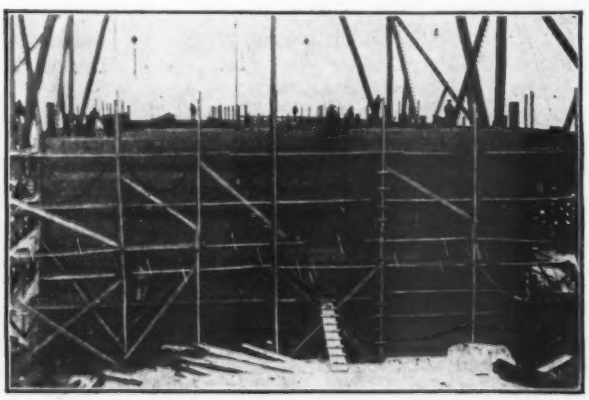


FIG. 4. CAISSON FRAMES ON GROUND BEFORE BEGINNING OF SINKING

Distribution from the tower was handled in a novel way. A low fixed tower on the center of the caisson carried a distributing box from which chutes running in two directions could be supplied. The last chute led to the top of a tremie hung from the boom of the derrick. By means of this tremie it was possible to control the flow of the concrete at will and hold the height of drop down as might be desired.

### Concreting the Pumphouse Substructure

The seal course of concrete included the lowest set of strutting of the caisson. For the actual substructure concrete above this level it was important to leave no timber embedded in the concrete. This determined the order of operations in concreting.

The substructure concrete was put in in lifts corresponding to the height between sets of bracing struts and was in all cases so arranged as to leave the bracing struts exposed for removal. In this operation the concrete forming the walls of the inlet and discharge passages, etc., was not placed, to avoid having it cut up by the construction joints between successive lifts. The concreting in lifts comprised a skeleton of the substructure sufficient to form a body for bracing the caisson walls after removal of the timber strutting. In the spaces within this skeleton the finished concrete work of the passages was subsequently placed around forms.

Fig. 3 shows the series of lifts and how they were arranged in order to provide support for the caisson walls by concrete as close as possible to the struts to be removed. At the pump inlet and discharge openings there are only narrow ribs of concrete between the several openings or chambers, and, as the clear width across the openings is large, the framing at these points had to be designed carefully to transmit the wall pressure to the concrete.

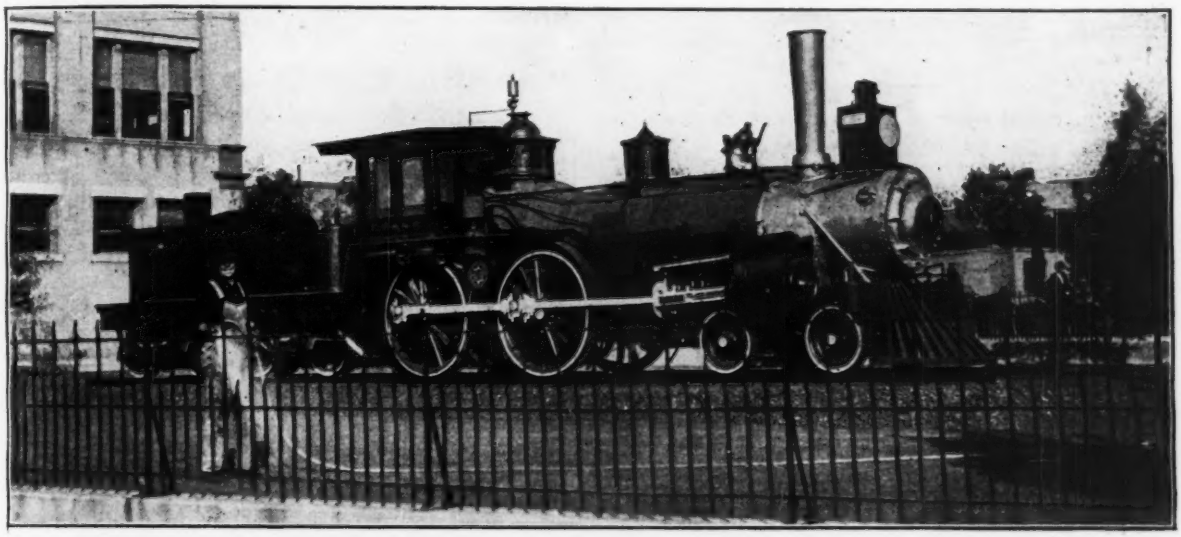
The caisson was designed and sunk by the Jarrett-Chambers Co., Inc., of New York City, which is also constructing the discharge flume and the superstructure of the pump house.

**Riverfront Improvement in Des Moines, Iowa,** is planned to include paving both banks of the river from Locust St. to the railway tracks with sheet asphalt, putting in 12-ft. cement walks on either side and installing electroliers along the walks. Harry B. Frase, superintendent of the Department of Parks and Public Property, states that present plans for riverfront improvement, other than the foregoing, are indefinite.

## An 1857 Locomotive Parked

Locomotives as monuments of railway and locomotive history are not frequently seen. It is therefore of interest to note that locomotive No. 1 of the El Paso & Southwestern Railway System has been installed as a monument in the park adjacent to the railway company's office building at El Paso, Tex. It is shown in the accompanying view, but as originally built it had a short smokebox and "woodburner" smokestack (of inverted cone shape), instead of the extension front and straight stack added later. The cab, bell, sandbox, dome, short wagon-top boiler, side-rod ends and other features show decidedly old-fashioned characteristics.

This engine was built in 1857 by Breese & Kneeland, of Jersey City, N. J., for the Milwaukee & Prairie Duchesne Ry. Later it became the property of the Chicago, Milwaukee & St. Paul Ry. It was afterward purchased by the Arizona & Southeastern Ry., now a part of the El Paso & Southwestern System, and was in service on this road from 1888 till 1904. In 1909 it was installed in the park, as shown. It is interesting to note that the tractive power of this little 4:4:0 engine is 7,000 lb., while that of the latest 2:8:2 freight locomotives on the same road is 60,000 lb. Information has been furnished by J. L. Campbell, Engineer of Maintenance of Way, and T. Paxton, Superintendent of Motive Power.



LOCOMOTIVE NO. 1 OF THE EL PASO & SOUTHWESTERN RY., IN SERVICE 1857 TO 1904

## What California Has Done with an $18,000,000 Road Fund

The $18,000,000 appropriated by the California State Highway Act of 1909 for road improvement will be practically all expended during the current year. The unexpended balance on Apr. 15, 1916, was $1,900,000, but nearly all this is needed to complete roads already under contract. A new $15,000,000 bond issue is asked for by the State Highway Commission, of which Austin B. Fletcher is chief engineer.

The following statistics from the July issue of the *California Highway Bulletin* show what has been accomplished thus far with the original bond issue:

| | | |
|---|---|---|
| Miles of road surveyed | | 2,286 |
| Miles of right-of-way secured | | 1,705 |
| Acres of right-of-way secured | | 13,327 |
| Miles of highway constructed: | | |
| Oiled macadam | 129 | |
| Concrete pavement | 933 | |
| Asphalt | 33 | |
| Graded | 395 | |
| Total | | 1,490 |
| Miles of roads paved by counties and taken over, improved and maintained by the state | | 108 |

11,750,000 cu.yd. earth and rock moved at average cost of 38c.
8,750,000 sq.yd. concrete pavement laid at average cost of 74½c.
1,000,000 cu.yd. concrete pavement laid at average cost of $6.84.
143 grade crossings eliminated.
200 mi., approximately, saved on the trunk lines.
443 bridges secured from counties of aggregate value of $3,450,000.

Eliminating advance surveys and materials on hand, out of every dollar expended 87½c. went directly into the roads in materials bought at "rock-bottom" prices and contracts let under keen competition.

The remaining 12½c. represents every other character of expenditure, including costly preliminary studies of mountain laterals and expensive aid given to many counties.

The Highway Act of 1909 called for the construction of nearly 2,900 mi. of road, an average allowance of approximately $6,200 per mi., including expenses of every nature. State highways in other states under comparable conditions have cost from $10,000 to $20,000 per mi. Hence it is not surprising that only about one-half of the projected mileage in California has been improved under the original bond issue.

**Renewal of the Missouri River Bridge** of the Union Pacific R.R. between Council Bluffs, Iowa, and Omaha, Neb., is now under way. It includes renewing all the steel work, revising the foundations for the approach spans, and raising the grade about 2 ft. The main part of the bridge consists of four double-track through, pin-connected Pratt truss spans with curved top chords, each span being 246 ft. 3 in. long. These are over the main channel of the river. The east approach has one through riveted double-track lattice span of 120 ft. 9 in., three deck plate-girder spans of 66 ft. and one of 50 ft. The plate-girder spans are supported on steel bents. The west approach has two through riveted double-track lattice spans of 120 ft. 9 in. and 129 ft. 6 in., and two deck plate-girder spans of 67 ft. and 50 ft. The plate-girder spans and the west end of the longer truss span are supported on steel bents. The foundations for the approach spans are of concrete on piles cut off below low-water level. The bridge was built in 1872 and partly rebuilt in 1887. The American Bridge Co. has the contract for the new steel work and its erection. The work is under the direction of R. L. Huntley, Chief Engineer of the Union Pacific R.R.

## Railway Improvements at Clinton, Iowa

Improvements on the Chicago & Northwestern Ry. at Clinton, Iowa, will provide better station facilities and reduce the blocking of street traffic by the trains and yard movements. The conditions are shown clearly in Fig. 2. From the west end of the Mississippi River bridge the line is now at the street level and has a descending grade for the greater part of the distance, rising then to the entrance of the freight yards.

The line will be raised so as to cross over 2nd St., which is to be depressed, as shown in Figs. 1 and 2. The bridge will be fan-shaped in plan and will carry eight tracks. Three streets near the new station will be closed, but a 60-ft. roadway parallel with the right-of-way will give improved means of access. Another

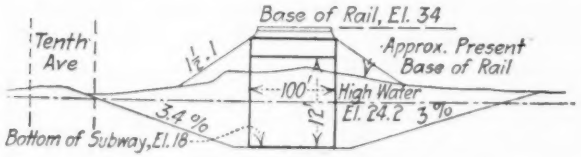



FIG. 1. CROSS-SECTION AT SECOND ST. SUBWAY; CLINTON, IOWA

street, at the entrance to the freight yard, will be closed also. Two street crossings will remain at grade, but they will be protected by gates and switchmen. The entrance to the freight yard, as shown on the plan, is shifted westward of the present position.

The present passenger station is a frame structure south of the tracks, at the west side of 2nd Ave. The main part of the city is north of the tracks, and the new station will be on this side, at the end of 11th Ave. (closed), having a 60-ft. approach driveway connecting with adjacent streets. The station will be a one-story building having exterior walls of brick with stone trimmings and tile roof. A separate building will provide for the baggage and express business. There will be two platforms 880 ft. long. The one in front of the station will be 20 ft. wide, and the one between tracks will be 16 ft. wide. These will have shelter sheds of steel construction with composition roofing.

A new freight station, to be built at 3rd St. and 8th Ave., with driveway entrance on the latter, will have a brick building 40x270 ft. and will be approached by tracks extending through the team yard shown on the plan. This freight house is to be built in 1916, as it must be completed before the track changes necessary for the new passenger station can be made. It is planned to build the station in 1917 and the 2nd St. subway in 1918. The improvements have been designed under the direction of W. H. Finley, Chief Engineer of the Chicago & Northwestern Ry.

There are now two other railway stations: That of the Chicago, Burlington & Quincy R.R. and the Rock Island Lines is just south of the present Northwestern station; the Chicago, Milwaukee & St. Paul Ry. has a station farther east, on the river front. There is a movement to secure joint use of the new Northwestern station by all the railways. This plan is being supported by the Association of Commerce, the railway committee of which is headed by C. P. Chase, consulting engineer.

## Planning Problems of Cities in the Smaller Class*

By John Nolen†

This paper is to be devoted to the problems of cities with a population of approximately 100,000, or which will soon reach that size. The planning problems of the smaller cities are very much like those of the larger cities, except that the smaller cities have an opportunity to head off and avoid many of the evils resulting from the early lack of proper planning on the part of cities that are now large.

A notion prevails that comprehensive plans are needed only for large cities. The reverse of this is nearer the truth. In large cities the conditions are comparatively fixed and unyielding. Comprehensive planning, especially with our present legal limitations, can occupy only a limited field in larger places, relieving only the worst physical

*Condensed from a paper before the City Planning Conference, Cleveland, Ohio, June, 1916. The paper is printed in full in "The City Plan" for June, 1916, the official organ of the National Conference on City Planning (19 Congress St., Boston, Mass.).

†Landscape Architect, Cambridge, Mass.

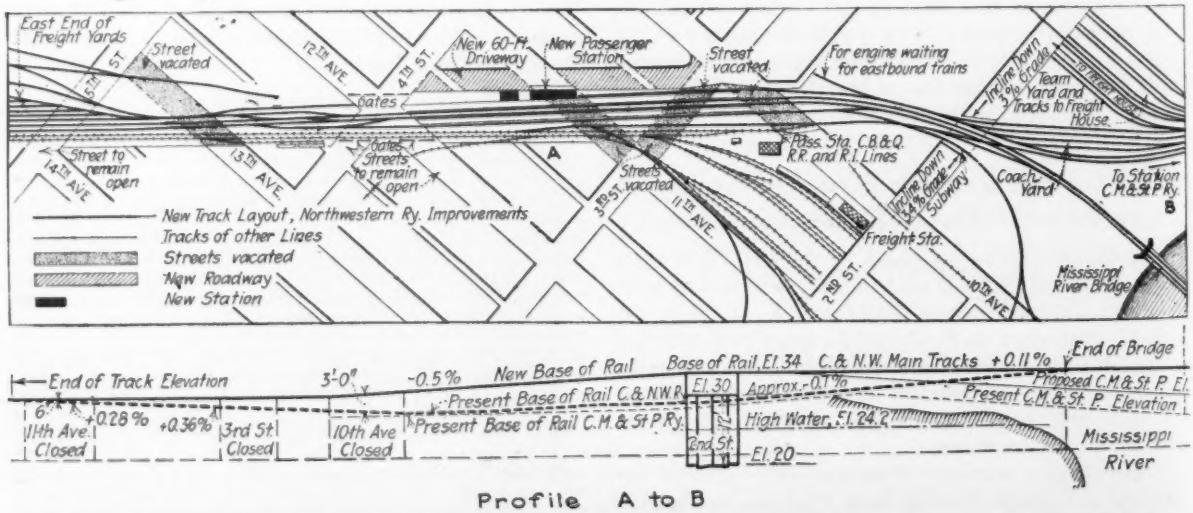



FIG. 2. PLAN AND PROFILE OF IMPROVEMENTS ON THE CHICAGO & NORTHWESTERN RY. AT CLINTON, IOWA

conditions. In the smaller cities streets can be widened, transit systems properly outlined, building districts defined, park and recreation areas selected, public buildings grouped and a scheme of planning adopted which will have unity and character. All of these elements of a city plan, almost indispensable sooner or later to the progressive community, may be had in the small city with relative ease and at slight cost.

The safeguarding regulations which should be considered and, if approved, adopted by local authorities, are as follows:

1. The minimum width for main thoroughfares and the reservation of land necessary for the same.

2. Provision for narrow streets and roadways of short length in many residential areas.

3. The establishment of building districts defining zones for factories, dwellings, etc., with regard to use, and also the bulk (height and area) of buildings allowable.

4. Provision for some systematic setting aside of open spaces for public use in connection with the extension of the town or city, just as streets are now usually set aside.

5. The approval of land subdivisions by local public authorities.

In connection with these safeguarding regulations it should be established that property would not be deemed to be injuriously affected by reason of provisions which prescribe the minimum space necessary around buildings, their height, area or character, or which limit the number of buildings to be erected in a given area. There should also be public power to purchase or expropriate land necessary for these wider public purposes, including, when desirable, land within 200 ft. of the boundary lines of any street, park or other public property.

The town or city should have all the power necessary to make systematic local surveys and to provide a general town or city plan, including the appropriation of the necessary funds, which in view of the fact that such surveys are largely for the benefit of future generations might, if it were deemed wise, be provided for by bond issues. While it should be noted here that more than one-half of what is important for towns and cities, especially the smaller ones, could be accomplished by regulations involving practically no expense, nevertheless I believe that early planning, at least general planning, is equally important, and in order that the regulations already referred to shall be wisely placed, a general plan based upon a local survey should be prepared as early as practicable. One need, then, of the smaller cities is for some method that would bring action on the part of the town or city early enough and of the right character so as to avoid unnecessary waste and mistakes.

## Cost Analysis of Asphaltic-Concrete Pavements

An accurate analysis of the cost of constructing 18,000 sq.yd. of asphaltic-concrete pavement, at Albany, Ore., was made by John R. Penland, City Engineer. The work was done under an unusual contract which gave the engineer access to all of the contractor's accounts. Hence the costs given are actual costs to the contractor and are not based on an inspector's estimates.

The pavement had a 1½-in. top and a 3½-in. asphaltic-concrete base, or a total of 5 in. Mr. Penland came to the conclusion that the actual material and labor costs should not exceed 68c. per sq.yd., and that with all general and overhead expenses and a reasonable profit this pavement should be laid at a contract price of $1 per sq.yd. A contract was finally let for the work in question at a price in excess of this figure, or $1.15 per sq.yd., but with the stipulation that Mr. Penland should have access to all the contractor's records and accounts, including his bank books and checks.

The mixture was a gravel asphaltic concrete. The top practically corresponded to the well-known Topeka specification, while the base was a coarser and dryer or more open mixture. The asphalt used was the California "D Grade," which is prepared at the refineries and is shipped in barrels for use without fluxing.

The mixing was done in an "Equitable" portable plant of 800 sq.yd. daily capacity, the heating drum being fired with crude oil, while the asphalt kettles were fired with wood and with staves from the asphalt barrels. The plant force in general consisted of nine men, and, with the exception of the foreman, were in the beginning unused to this class of work. The output of the plant, after the work had been organized, was about 800 sq.yd. of base and 1,200 sq.yd. of top, per day. In laying the pavement, the top and base were spread, raked and rolled separately.

The detailed costs of labor and material obtained by Mr. Penland fully confirmed his original estimates. The average for the entire job showed 28c. per sq.yd. for the 1½-in. top and 37c. for the 3½-in. base, a total of 65c. for the 5-in. pavement.

The detailed costs of the Albany work are available for a week's run in the middle of the job, after the labor had been broken in, and perhaps show more representative conditions than the cost on the entire job:

COSTS PER SQUARE YARD FOR ONE WEEK'S RUN; ALBANY, ORE., ASPHALT PAVING

| Item | Unit Cost | Cost: Top, 1½ In. | Cost: Base, 3½ In. | Cost: Total, 5 In. |
|---|---|---|---|---|
| Gravel, per cu.yd. | $0.86 | $0.013 | $0.062 | $0.075 |
| Fine sand, per cu.yd. | 1.50 | .032 | .026 | .058 |
| Coarse sand, per cu.yd. | 1.80 | .058 | .024 | .082 |
| Asphalt, per ton | 12.00 | .089 | .078 | .167 |
| Fuel oil, per bbl. | 1.25 | .008 | .016 | .024 |
| Coal | .... | .003 | .005 | .008 |
| Wood, per cord | 4.00 | .002 | .005 | .007 |
| Plant labor | .... | .031 | .052 | .083 |
| Street labor | .... | .032 | .044 | .076 |
| Teams | .... | .008 | .013 | .021 |
| Totals | .... | $0.276 | $0.325 | $0.601 |
| Amount laid (sq.yd.) | | 5,204 | 1,548 | |

In addition to the above, a contractor's costs would include plant charges, overhead and profit. The mixing plant used for the Albany work cost new about $6,000. The owner of this plant, after the completion of the job, offered to rent it to the city for 5c. per sq.yd. of pavement laid with it. While such a figure might represent a legitimate charge for a municipally owned plant, it would seem rather low for contract work, where ordinarily freight charges for shipping in a plant from outside would have to be met. A plant charge of 10c. would however cover almost any contingency of contract work. In addition to this, the charge for roller and for small tools would run about 5c. per sq.yd. To summarize, an equitable contract price for the conditions represented by the Albany, Ore., work would be as follows:

| | Per Sq.Yd. |
|---|---|
| Labor and material (actual cost) | $0.65 |
| Mixing plant (interest, depreciation and repairs) | .10 |
| Roller and small tools | .05 |
| Overhead (10%) | .08 |
| Profit (10%) | .08 |
| Total | $0.96 |

## Copper-Sulphate Treatment of St. Paul Water-Supply

A successful campaign against tastes and odors due to organic growths in the water-supply of St. Paul, Minn., was conducted in 1915, along lines recommended the previous year by Allen Hazen, consulting engineer, New York City. The campaign was in direct charge of N. L. Huff, Professor of Botany, University of Minnesota, under G. O. House, general superintendent of the St. Paul Bureau of Water. The following information is taken from a paper by Professor Huff, read before the convention of the American Water-Works Association in New York City last June. (The paper appeared in the *Journal* of the Association for June and has also been reprinted for Professor Huff.)

The water-supply of St. Paul is taken from a series of lakes. A laboratory was established on the lower one and a careful study made of the organisms in the lake before and after treatment with copper sulphate. The lake as a whole was treated three times, at a cost of $180 for material and $17.50 for labor each time. Special treatment of troublesome coves and shallows was also made at slight expense. The result of the treatment was a material reduction in the number of complaints of bad taste or odor from consumers.

The paper describes all the governing conditions and gives the mode and results of the treatment in detail. In conclusion, after naming the various classes of green and blue algæ, diatoms and protozoa found in the water during the campaign, Professor Huff says:

> With conditions under which above treatments were made, a treatment of one part of copper sulphate in 10,000,000 parts of water remains effective for about five weeks, after which time the organisms present, or many of them at least, seem to find conditions favorable for their growth and reproduction, and if the treatment is not repeated at this time they may increase again with remarkable rapidity.
>
> Where quiet shallow bays afford breeding places for numerous organisms, or where any one or more organisms become abundant in small or limited areas, local treatment or the application of small quantities of copper sulphate to the particular spot where the trouble is originating, has been found very effective. If careful attention is given to such areas, and accumulations of organisms prevented here, the number of general treatments necessary to keep the lake clean for the entire season may be lowered and the total cost of treatments materially reduced.
>
> For treatment of very shallow bays, flat muddy shores and small ponds the use of a hand pump such as is used for spraying trees is a practicable and economical means of distributing copper sulphate. In addition to spreading the solution in places inaccessible for a boat, this method has the advantage of leaving the water unrolled and gives the organism the full effect of the copper, much of which might otherwise be absorbed by mud and organic matter stirred up by a boat in such places.

## K-Truss Bridge of Santa Fe Across Arkansas River

A bridge built recently by the Atchison, Topeka & Santa Fe Ry. has riveted trusses with K-system web instead of the usual subdivided panels. In each panel there are two diagonals, extending from the middle of one post to the top and bottom of the next post. This K-type of truss is used also in the Quebec Bridge.

The Santa Fe Ry. bridge was built rather as an experiment to determine whether the weight and cost of this design would be less than for the ordinary design. The details are found to be heavier than in the latter. The results indicate that the K-truss is not economical for spans as short as 230 ft., but would be decidedly economical for spans of 300 ft. and over.

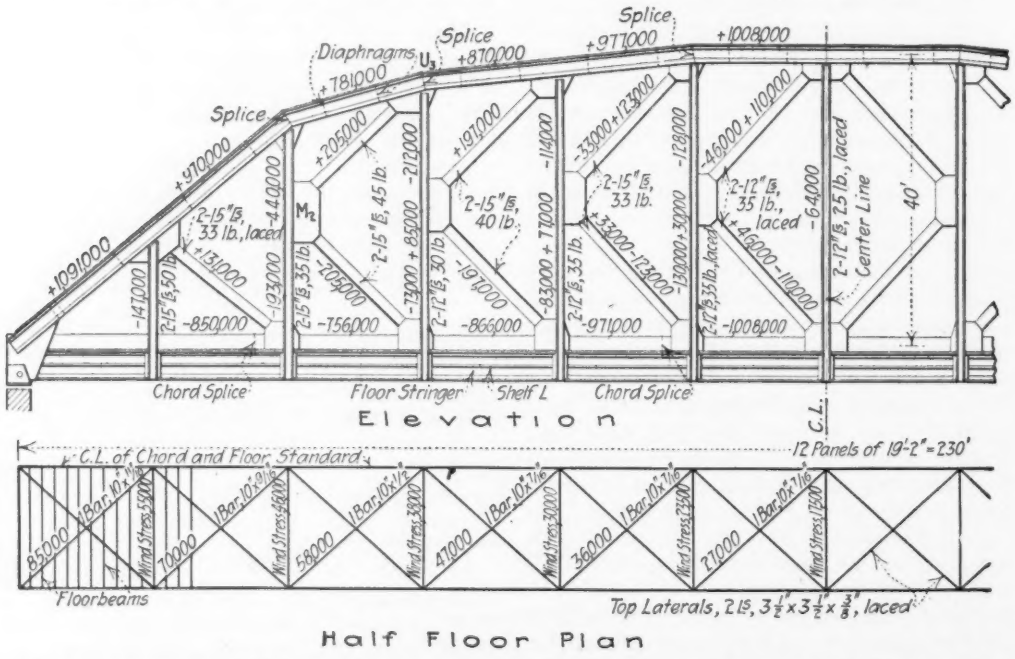



FIG. 1. GENERAL DESIGN OF K-TRUSS BRIDGE FOR THE ATCHISON, TOPEKA & SANTA FE RY.

The bridge crosses the Arkansas River at Pueblo, Colo. It is 230 ft. long c. to c. end bearings and has through trusses 40 ft. deep at the center, spaced 16 ft. (14 ft. clear between the trusses). The clearance height is 22 ft. 6 in. from base of rail to the sway-bracing struts.

The bridge is designed for the railway company's heavy-grade live-load, which is about equivalent to Cooper's E-65 loading. The axle load for the floor is 66,000 lb.

The heavy floor framing is assumed to take 25% of the lateral force. The assumed dead-load is 6,000 lb. per ft. of span, as follows: Steel, 3,950 lb.; timber deck, 270 lb.; ballast, 1,580 lb.; ties, 100 lb.; rails and fastenings, 100 lb. The shipping weight of the span was about 512 tons.

The top chord is of box section, of very heavy construction It has two 26-in. web plates on each side (½ to ¾ in. thick), four outside flange angles 6x4x¾ in. and a

The top laterals are pairs of 3½x3½-in. angles, laced. The top struts are composed of four angles, with vertical lacing for the web. Beneath them is the sway bracing, with diagonals and bottom struts composed of pairs of angles 5x3½ in. The bottom lateral diagonals are 10-in. bars, $\frac{7}{16}$ to $\frac{11}{16}$ in. thick, riveted to the bottoms of the posts.

The ends have pin bearings in the shoes, and at the expansion end each shoe has a nest of nine segmental

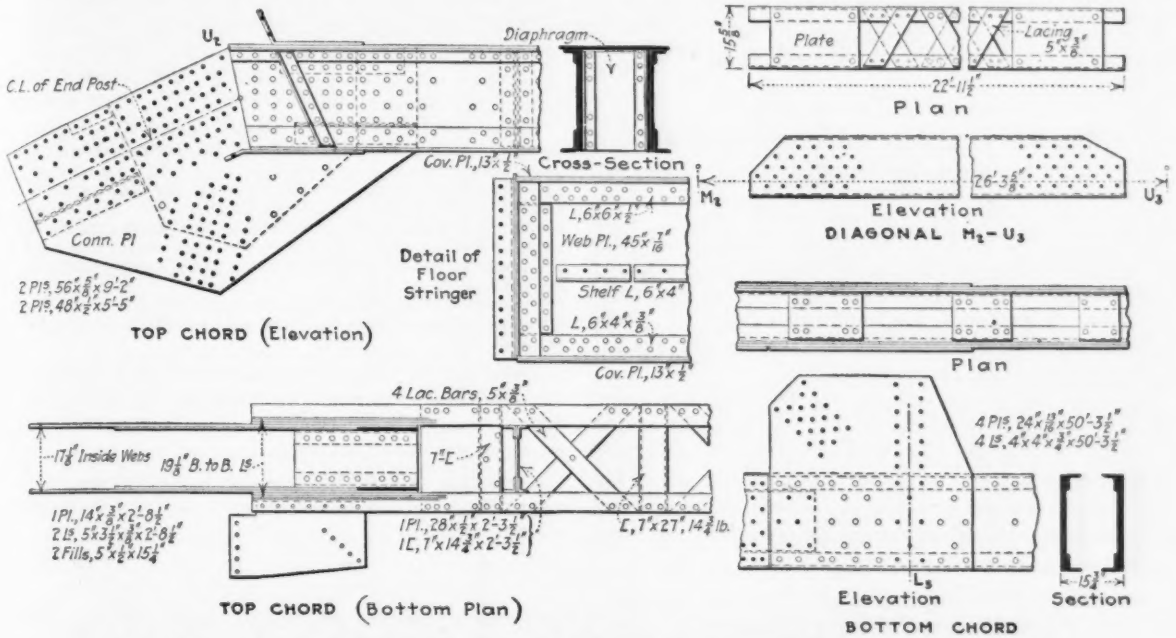



FIG. 2. DETAILS OF K-TRUSS BRIDGE ON ATCHISON, TOPEKA & SANTA FE RY. AT PUEBLO

⅝-in. top cover plate 28 in. wide. Across the bottom flanges is a lacing of bars 5x⅝ in., with struts of 7-in. channels between the lacing sets. The chord is stiffened by vertical diaphragms of ⅜-in. plates and four angles 5½x3½x⅜ in., there being two of these to each panel. The bottom chord is similar, except that it has the flange angles on the inside. It is composed of four 24-in. web plates (two on each side), ½ to $\frac{13}{16}$ in. thick, and four angles 4x4x¾ in., with top and bottom batten plates.

The posts and diagonals are pairs of 12-in. and 15-in. channels, with flanges turned outward for the posts and inward for the diagonals. The channels are connected by batten plates and lacing bars 5x⅜ in. These bars (in the chords as well as the web members) are notable for their width (5 in.), which allows two rivets in each end. The connection plates are large and allow for ample riveting.

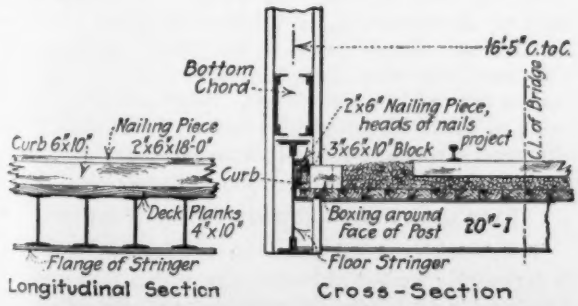



FIG. 3. SOLID-FLOOR CONSTRUCTION OF THE ARKANSAS RIVER BRIDGE

rollers 6x3 in., 4½ ft. long. Four tooth-bars projecting above and below the rollers engage pockets in the bridge plate and base plate, so that any movement of the bridge must operate the roller nests.

The structural material is openhearth steel of 55,000 to 65,000 lb. ultimate strength and an elastic limit of 55% of the ultimate strength. The rivets are ⅞ in., with $\frac{15}{16}$-in. open holes. Holes in the chord splices are reamed with the chord sections assembled in the shop, in order to secure fair holes. All the other work is punching and riveting without any reaming. A coat of raw linseed oil was given at the shop, and surfaces that would be inaccessible after assembling were given two coats of paint. After erection the steel was cleaned with wire brushes and scrapers and then given two coats of paint, as is general practice on this road.

### Solid-Floor Construction

The floor system is of special interest, though it is not peculiar to this bridge, being the railway company's standard I-beam floor for ballasted-deck construction. There are no plate-girder floor-beams, as in ordinary construction, and the stringers—instead of being placed under the track—are placed directly under the bottom chords, being framed between the truss posts. These stringers are 45-in. plate girders, with $\frac{7}{16}$-in. webs, top flange angles 6x6x½ in. and bottom flange angles 6x4x⅝ in.

On the bottom flanges of the stringers rest transverse 20-in. I-beams, spaced 20 in. c. to c. These are secured by shelf angles 6x4 in., riveted to the stringer webs.

Upon the I-beams is a deck of longitudinal 4x10-in. creosoted planks, with a 6x10-in. curb on each side to retain the ballast. The curb is held by a flat nailing piece that bears against the web of the stringer and can be easily removed for inspection or painting of the steelwork. Boxing of 4x10-in. pieces keeps the ballast away from the truss posts. The ballast is about 7 in. deep under the ties.

The bridge was designed under the direction of A. F. Robinson, Bridge Engineer of the Atchison, Topeka & Santa Fe Ry. It was built by the American Bridge Co.

## Exact Imitation Infringes Trade Rights

In a case before the Supreme Court of New York County, decided by Judge Shearn on June 20, where a competing manufacturer of a device made an exact copy of his competitor's production, his object being apparently to deceive a purchaser, the court ruled that such a proceeding was unfair competition and the plaintiff was entitled to a judgment and an accounting.

The plaintiff in the suit was the Diamond Expansion Bolt Co. and the defendant the United States Expansion Bolt Co. The plaintiff has built up in the last seventeen years a large business in the manufacture and sale of lag shields and anchors, and was the pioneer in introducing them to the trade. Other manufacturers entered the same field with widely different forms of shields and anchors. The lag shield designated as the "diamond" shield was put on the market by the plaintiff in 1910 and 1911. In 1913 the defendant placed upon the market a rival lag shield and anchor which to external appearance was a Chinese copy of the plaintiff's device but differed slightly from the plaintiff's in a hidden feature which was patented. In marketing this device the defendant widely advertised a cut of 25% in the prices maintained by the plaintiff, used underhand attempts to hire the plaintiff's important salesmen, and declared to the trade that its devices were identical with those of the plaintiff. The court in its decision said:

> It is, of course, true that where a design is not patented there is no exclusive legal right to its use per se, and apart from patent rights, one may copy with exactness that which another has produced without inflicting any legal injury, unless he attributes to that which he has made a false origin, by claiming it to be the manufacture of another. On the other hand, where an article of distinctive appearance has been on the market in that form for a long period and has been popularized and identified with its manufacturer through advertising and general use, its distinctive appearance gradually becomes as important a representation of its origin as its trademark.

The court ruled that from the evidence it was clear that the defendant, who made the Chinese copy of the plaintiff's devices, believed they would sell better if their appearance were identical with the form so popularized by the plaintiff. The court ruled that this constituted unfair competition and a judgment and accounting for the plaintiff was ordered.

# Air-Diffuser Experiences with Activated-Sludge Tanks

*SYNOPSIS—Differences of experience and opinion as to the use of porous-block and perforated-pipe diffusers for intimately mixing air and agitating sewage in activated-sludge tanks are expressed by engineers in charge of test and working plants at Milwaukee, Baltimore, Brooklyn, Cleveland, Urbana and Chicago.*

In the design and operation of activated-sludge tanks questions that have received considerable attention and will probably be given much more are the possible clogging of the "filtros" or other porous blocks used for diffusing the air as it is forced into the bottom of the tank and up through the sewage, and the relative advantages of porous-block and perforated-pipe diffusers.

It is well known that in other mechanical operations where a large volume of air has to be forced through restricted passages the latter become clogged with dust and dirt and must be regularly cleaned or the flow of air will be interrupted; at least, this will happen unless the air is first washed or otherwise cleaned of dust. To what extent is this same trouble likely to arise in porous diffusers in activated-sludge tanks? In dealing with this general question in the discussion relating to experience at Milwaukee there appeared in *Engineering News* of Feb. 10, 1916, p. 263, in the course of some remarks by T. Chalkley Hatton, a statement that there was no trouble from clogging in the large tanks at the Milwaukee testing station. The air, however, is filtered through excelsior placed in the air-feed pipe. The experience at Milwaukee also showed that there was no trouble during nine months' operation from filtros block clogging from the sewage itself.

Subsequent to the appearance of the article on the Milwaukee plant, a member of the editorial staff of *Engineering News* visited the large Imhoff tank at Baltimore, where under the direction of Calvin W. Hendrick, Chief Engineer of Baltimore, and Leslie G. Frank, Sanitary Engineer, United States Public Health Service, one of the large new Imhoff tanks has been adapted to serve as an activated-sludge tank. The experiences at Baltimore being somewhat at variance with those at Milwaukee, it seemed desirable to appeal to the engineers who have been most intimately connected with activated-sludge work in this country, asking them to summarize their experiences with air distribution in its relation to clogging of porous distributors. The responses to this request have brought out some interesting facts regarding perforated-pipe as well as porous-block distributors. Below are printed staff notes on the Baltimore plant, kindly revised by Mr. Hendrick and supplemented by Mr. Frank, together with notes from various other localities and engineers.

### Baltimore Notes: Revised by Mr. Hendrick

The air supply at Baltimore before passing to the blower is thoroughly washed to remove any dust it may contain. This washing is effected by passing the air through a 12-ft. length of a 12-in. cast-iron pipe set vertically. The

air enters at the bottom and passes upward through gravel with an approximate diameter of 3/8 in. This gravel layer is supported 18 in. from the lower end of the pipe by a grid and extends to within 3 ft. of the top of the washer. A small stream of water is trickled through the gravel from the top and is taken off at the bottom by a float-actuated valve. The air at Baltimore is compressed by a rotary compressor having an eccentric rotating piston that requires a great deal of lubrication. Notwithstanding the thorough washing that the air receives before going through the blower, there has been found on the inside of the porous blocks[1] a deposit of oily sludge. This, it is supposed, comes from the lubrication process already mentioned. It is hoped that the oily deposit in the blocks can be avoided by substituting a rotary compressor of the gear type, or a high-pressure centrifugal blower (neither of which requires internal lubrication), for the kind of blower referred to above.

### Mr. Frank on Experience at Baltimore

The diffuser grid installed in the activated-sludge tank was first provided with carborundum disks, grit 120, the influent air being washed as is described above. Two facts soon become evident—that an oily sludge accumulated on the bottom surfaces of the disks and that the air washer removed practically as much oil without the water stream as with it. The whole gravel layer soon became heavily coated with an oil film, and this oil film was as good or probably better than a water film for the removal of dust and oil particles. Neither oil film nor water film, however, removed the *oil vapor* that had been generated by the heat of compression, the air detention period in the washer being insufficient to effect its recondensation. This oil vapor, therefore, passed down into the manifold and condensed on the cold under-surfaces of the diffusers, gradually forming a sort of oily sludge compost with the particles of sludge that worked their way into the grid in times of shut-off. This oily sludge rendered the carborundum disks almost impervious to air and caused us to substitute filtros therefor. The same accumulation of oily sludge has been observed on the underside of the filtros plates, but owing to the greater porosity of this material the corresponding increase in resistance has not been so great as in the case of carborundum.

At present (Apr. 29) the air-compressor capacity is being greatly increased by the installation of a Connersville blower, and it is hoped that at the same time the oil difficulties will be obviated due to the fact that this type of blower requires no internal lubrication, as in the case of the blower heretofore used.

Since the above was put in type, Mr. Hendricks informs us under date of July 11 that a Connersville blower with a capacity of 195 cu.ft. of fuel air per minute has just been installed and the porous area of the grill has been doubled. Experiments on this installation have just began.

### Milwaukee, Wis.: T. Chalkley Hatton*

As to the experience of Milwaukee I might repeat the statement in *Engineering News* of Feb. 10, 1916, in which I said that no trouble from the clogging of the filtros plates had been so far experienced at the Milwaukee testing station—that is, clogging due to the passage of the air through the plate. We have occasional clogging on the top of the plate, owing to the very heavy sludge temporarily alighting thereon and not being lifted through the body of the liquor.

We think this is due to the character of our sewage in that it carries a great deal of waste, entrails from the packing-house district, small pieces of leather from the tanneries and large quantities of hair. All this becomes massed together. The specific gravity, being thus largely increased, overcomes the tendency of the air to keep such masses in constant suspension. We think much finer screens than we now use will largely overcome this difficulty.

The Connersville blower, which we are operating, was designed with a view of preventing any lubricating oil used in the blower from getting into the discharge pipe, and the wood wool placed compactly in the filter seems so far to have intercepted the dust carried by the air.

While we have not removed any plates that have been in operation more than two months, there is no visible evidence in the operation of our plant that these plates are not giving just as good diffusion as when they were installed. Two months after our new and large fill-and-draw tank was first placed in operation we did remove some of the plates from it and carefully examined them for porosity. We found that they were in the same condition in this respect as when they were first introduced.

From the notes furnished me of the Baltimore experience I should attribute the trouble to the lubricating oil from the compressor. This would not be entirely removed by the washing of the air. In fact, I do not place as much dependence upon the washing of the air as upon a good filter. Whether the wood wool is the best medium for this filter or not, I am not prepared to say, but so far it has been successful with us. It is cheap, easily examined, easily removed and replaced.

We are now experimenting with a diffuser made of basswood, cut at right angles to the grain. We have made several experiments on woods of different characters, but find basswood so far is the most reliable and gives the best diffusion with the least frictional loss. The air appears to be uniformly distributed in smaller bubbles than from the filtros plates, but whether the wooden disk will prove practical or not is a question yet to be determined.

We are trying 8x10-in. plates to determine among other things the total swelling of the wood, the uniformity of porosity during long-time service and the possibility of decomposition through aërobic action or through chemical action due to contact with the sewage. These, of course, are matters that can only be determined after considerable careful investigation.

### Brooklyn, N. Y.: George T. Hammond*

The activated-sludge method of sewage treatment is so recent that it is not surprising if we have not yet learned the best technic of applying the principle in actual practice. The first experiments were made on a laboratory scale, or with apparatus designed for other methods of treatment, which could be modified for immediate use in temporary experimental plants. Resort to the actual trial of apparatus was the best, if not the only, way to gain essential working knowledge before serious problems in

[1]Carborundum disks of 120 grit were first used, but the differential pressure required to force the requisite amount of air through rose so rapidly (from less than 1 to over 5 lb. per sq.in.) on account of clogging that filtros was substituted.

*Chief Engineer, Sewerage Commission, Milwaukee, Wis.

*Engineer of Design and in Charge of the Sewage Experimental Plant, Bureau of Sewers, 215 Montague St., Brooklyn, N. Y.

design could be undertaken; and indeed these trials and experiments are as yet unfinished, and it is still too early to anticipate their results.

It is scarcely a year since the first plant on a working scale was put into service. While we may not forecast results, it is quite safe to hazard the opinion that several years must elapse before sufficient data of a satisfactory kind will be secured to permit an adequate solution of some of the problems presented. Considering the short time that has elapsed, it is rather surprising how much progress has been made.

Air diffusion into the sewage has been attended with considerable trouble and affords one of the main problems involved in the application of the method.

The ideal air diffuser should give an easily controlled flow and volume of air, equally diffused to all portions of the tank, with bubbles of the "critical" size formed at the points of entrance. It should not tend to become clogged, or at least should not tend to unequal clogging. It should be readily cleaned in place without emptying the tank, or should be easily removable for replacement and for cleaning in case of clogging. It should show the minimum deterioration in service, and its cost should be reasonable.

The earliest aërator tanks of which the writer is informed employed grids of perforated pipe for this purpose. The experiments of Black and Phelps in Brooklyn were conducted with such grids, as was the continuous-flow aërating tank experimented with in 1914-15 at the same place. (See *Engineering News,* July 29, 1915.) These grids have uniformly given good service, if designed on correct principles, and have shown but little tendency to become clogged.

Porous material used to diffuse air has shown a tendency to progressive clogging. This may possibly be reduced to a minimum by various forms of air filters, placed in the supply line, which promise to render its use practicable. It has been employed because it gives a very fine bubble, and the entering bubbles are distributed over a wide surface. While clear and new, it gives the air diffused a higher efficiency than does the perforated grid. But in spite of every care this freedom of discharge and high efficiency seem not always to be maintained. From whatever reason, some of the porous plates come to pass the air less freely than others. Examination of a number of tanks supplied by air in this manner convinced the writer that there was in every instance a material variation in the diffusion of the air in different portions of the same tank. This was evidenced by violent local ebullitions and evident local streaming out of air, while other portions of the tank surface remained quiescent, or nearly so. Photographs taken of the surfaces of a number of these tanks sustain this observation.

It was also observed, where this phenomenon was seen, that for one or another assigned reason the aëration period had been, in all the cases observed, materially lengthened. This result was quite in accordance with the writer's own experience with the use of porous diffusers. We found that our disks clogged very unevenly and that the entire supply of air was discharged through the unclogged disk without showing any decrease in quantity by meter.

It seems obvious that the primary cause of this trouble is the fineness of the pore, or passage, through which the air is diffused. Even if all dust and other foreign material are excluded by means of air filters, various kinds of bacterial and other minute forms of life, etc., enter freely and may cause obstructing growths. The sewage directly over such plates may enter the pores and cause obstruction in various ways, among which may be mentioned deposits of mineral matters from solution. In short, there are many ways by which porous material can become clogged, even if the greatest care is taken to prevent it.

In view of the foregoing it seems desirable to find some other method of diffusion. Apparently the porous material answers only one of the above-mentioned ideal requirements of a distributor—that of giving a very fine size of air bubble.

Experiments have shown that the finer the bubble the more the pressure needed to distribute the compressed air and the greater the danger of clogging. The finer the bubble the greater its efficiency, but the more expensive the air. The tank efficiency is highest when its reliable average performance gives the effluent required at the least expense for air.

The experiments conducted in Milwaukee in 1915, reported by Mr. Hatton, seem to indicate that the porous material was rather the best for diffusing air, although he states that "there appeared to be little difference in the character of effluent obtained by the same volume of air, whether it was applied through an open jet or a filtros plate."

It seems to the writer, in view of this and his own experience, that the use of porous material for diffusion has largely grown out of theoretical rather than practical considerations and that further experimental work is very desirable. The useful age of service to be expected from a porous substance, it would seem, must be comparatively short, if we can depend upon our experience in other lines of work.

Our experience in Brooklyn has been in favor of the perforated grid, the pipes of which are placed not more than 12 in. apart and the perforation made of $\frac{1}{16}$ in. diameter, 6 in. c. to c. The grid in one tank aërator is still in service after over 2½ yr., during which time it has had no cleaning. The depth of sewage aërated is 22 ft., and the distribution is very good.

Another tank, in which distribution was provided by porous disks, was not so satisfactory on account of clogging. The phenomenon of clogging in this tank was rather interesting. Some of the disks clogged, while others did not. As a result, a greater volume of air entered through the unclogged disks, causing intense local surface ebullition and streaming out of air, while at other places the surface was quiescent. As there is always an excess margin of working pressure, increased volume of flow can readily occur through the unclogged diffusers; thus the entire metered flow of air will still continue to enter the tank, but it may not reach half of the sewage, and much of it escapes by streaming. Why employ the porous material, to obtain the most efficient size of bubble, in order to save a small per cent. of the air, if, as a result of the attempt, clogging or uneven distribution may occur and waste far more than could be saved by this means?

Unfortunately, there seems to be no satisfactory way to clean out the porous disks or plates, without removing them. This problem has been ingeniously handled at Baltimore, where the diffuser disks are mounted on a framework of pipes that may be closed like an umbrella and the entire mechanism withdrawn by a derrick. (See *Engineering News,* Apr. 27, 1916, p. 800.) This enables

the operator to remove and replace a disk at will; but where the porous plates are built into the bottom of the tank, as in some plants, it is too early to feel certain that they can be kept in good order. But as the surfaces of the air inlets must be as nearly absolutely level with each other as possible, it may be difficult to obtain this with a movable distributor.

In the design of a sewage-disposal plant refinements in operating parts are undesirable. The mechanism that shall give the most reliable average service will usually be selected. For diffusing air in a tank filled with sewage the writer's observation leads him, in the light of present knowledge, to prefer the perforated-pipe grid, although it will not give the most efficient size of bubble.

The grid may be so designed that, if necessary, it can receive frequent flushings from the city water-supply, which always has a greater head than the sewage in the tank; and it can be provided with drains, so that it may be flushed out with little trouble, without emptying the tank. Should the perforations become clogged with grease, the tank may be emptied and steam or hot water discharged through the grid. Possibly, further experiments may modify this opinion, which is offered by way of discussion on experimental work still in progress.

The question has several times suggested itself to the writer, "Would it not be possible to get along with less air by the use of mechanical agitation in the aëration tanks?" It would seem that much of the air applied at present is wasted, as it is only applied to produce agitation—a churning movement that seems to aid coalescence of the finer particles of colloidal matter, and facilitates the activation treatment. This has not been tried out so far as the writer is aware, but various means suggest themselves, such as paddles, screw propellers, movable air distributors designed to agitate the sewage and to diffuse air, jets of sewage discharged into the tank, if the sewage enters by pumping, etc. May not such a method greatly increase the effect of air, which could then enter by means of a rather coarse movable, or stationary, grid and be mechanically mixed with the sewage?

The importance of continuing our experimental work with the activated-sludge method of sewage treatment cannot be overstated, and every possible advantage should be taken of constructive criticism, as well as experimental work.

SANITARY DISTRICT OF CHICAGO: LANGDON PEARSE*

My personal experience with small experimental units was satisfactory, but in the plant put into operation by us in January, comprising four units, with a capacity of 35,000 gal. per day on a 24-hr. period, we have had considerable difficulty with the clogging of the plates. This apparently has been caused by the sewage, which contains a good deal of paunch manure, straw, hair and other material that will mat and clog. A recent examination of one tank with a nominal inside dimension of plan of 6x23 ft., with a single row of filtros plates down the center, indicates that all the plates have been broken. The breaks are apparently due to downward pressure. The plates were supported on two sides only, in wooden boxes, lined with galvanized iron, and were set in jointite. The use of wood probably caused the trouble, a more rigid frame being desirable. The distribution in the tank was seriously interfered with, a considerable deposit of hair and coarse sludge being found underneath the plates, many of which were badly shattered. We are endeavoring to find the exact reason for this difficulty, although it appears to be due to clogging and the loading of the water on top. No provision was made for back-flushing by water. For various reasons the air pressure has been shut off from time to time. The air distribution has been remodeled, the boxes being stiffened, and an additional support placed so that all plates are supported on four sides. This has proved satisfactory.

The air at our testing station is furnished by a rotary blower of the Connersville type, working against a 6-lb. head, the depth of water being 10½ ft. over the plates. We have a muslin screen on the intake of the blower. So far as we can ascertain, there has been no difficulty on the underside of the plates from any oily deposits, there being no trace of oil in the air boxes underneath.

In order to cure certain difficulties in measuring the air with a venturi meter, a steel storage tank 5 ft. diameter, 5 ft. high, has been installed. This reduces the pulsating effect and forms a trap for oil or moisture.

Before our experiments are concluded, I hope to run comparative tests on two tanks with perforated pipes and two tanks with filtros plates. I believe that considerable thought is still required to determine the proper design for the air-distribution system in order to make it satisfactory at a minimum cost.

I believe that *Engineering News* will do well to impress upon its readers the importance of going slow in the adoption of activated-sludge plants without thorough consideration of all the elements involved, as I think most of us still agree that it is not a simple process to operate, but one whose entire limitations are not yet developed.

The cost problem is still in the air, particularly the cost of handling the sludge. Another warning should also be issued on the short-time tests lasting only two or three weeks, which are liable to give misleading results, as it takes several months in general to determine the efficiency and limitations of sewage-treatment methods definitely. We have noticed in our work that good results are obtained for the first three or four weeks, and then difficulties begin to develop that were not anticipated.

HOUSTON, TEX.: E. E. SANDS*

Our experiments were all conducted with that variety of filtros manufactured by the General Filtration Co. and known as Grade 5-1. The catalog published by the company states that where there is a net head of 2 in. of water the capacity of a filtros plate 1½ in. thick and 12 in. square is 360 cu.ft. of air per hour, or 6 cu.ft. per min., and that the porosity of this plate or the per cent. of voids is 37.56%. It is evident that the tests from which this table was prepared were made with dry air and under dry conditions. When a filtros plate becomes wet, the porosity is reduced and its resistance to the flow of air increases. Careful experiments were carried on with the filtros plate in tank No. 3. This plate was submerged to a depth of 7 ft. 6 in. The air as it entered the plate was measured through an orifice in a thin plate located in an enlarged section of the supply pipe. When the plate was new, 150 cu.ft. of air per hour (measured under a water pressure of 8 ft.) required a net head of 6 in. After the plate had been used for 30 days in a tank operated on the fill-and-

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*City Engineer, Houston, Tex. The remarks here given are from Mr. Sands' "First Annual Report . . . on Sewage Disposal," dated Feb. 1, 1916.

draw plan, it was found that the same amount of air required a net head of 15 in.

After 40 days' use the following heads were required, the depth of sewage in the tank still being 90 in.:

| Air in Cubic Feet per Hour (Measured Under Pressure) | Head of Water, Inches | |
|---|---|---|
| | Total | Net |
| 50 | 102.2 | 10.5 |
| 75 | 102.22 | 12.22 |
| 100 | 104.1 | 14.0 |
| 125 | 105.82 | 15.82 |
| 150 | 107.53 | 17.53 |
| 175 | 109.20 | 19.20 |
| 200 | 111.10 | 21.10 |

Where the plate is in a fill-and-draw tank, every time the air is shut off a certain amount of sewage filters through the filtros plate back into the air pipe, and it is reasonable to assume that a small amount of sludge remains in the voids of the filtros plate and reduces its capacity.

Where a tank was used for a continuous flow, the resistance of the plate was not found to increase to any great extent, and it is believed that if a continuous-flow tank were supplied with filtered air the resistance of the filtros plates would remain nearly constant for any given climatic condition. It was observed, however, that the humidity of the atmosphere had a decided influence on the capacity of the plates. When the air was moisture-laden, the resistance of the plates was greatly increased. For this reason the use of a cheesecloth filter for the removal of dust from the air will give more satisfactory results than the use of an air washer. Such a filter will not remove as much dust as a washer, but a washer will cause an increase in humidity unless some cooling device is used.

Tank No. 3 was equipped for about 10 days with an aërator constructed of small brass tubing. This aërator consisted of a central head from which there radiated in a horizontal plane eight ⅛-in. brass tubes 6 in. long. An aërator constructed in this manner would work in a continuous-flow tank without any trouble, but when it was tried on a fill-and-draw tank it was found that the small tubes clogged up when the air was shut off and the sludge allowed to settle. As the water surface in the tank was lowered during the operation of drawing down the tank, the air held in the supply pipe between the valve and the aërator expanded and slowly escaped. Then when the tank was refilled, the sludge was forced into the aërator tubes and considerable difficulty was experienced in keeping this aërator cleaned out and in proper working condition.

All the mechanical difficulties of this could have been overcome without much trouble, but results of analyses made during the time this aërator was in use show a decided loss in efficiency. This is attributed to the fact that the air is not as finely divided by such an apparatus as it is by the filtros plate.

It is apparent that the operation of any large tank containing a great number of aërators requires careful consideration of the following conditions: When the air is turned on, a few aërators will handle a large quantity of air unless each aërator offers considerable resistance. This air will diminish the hydrostatic head over these aërators and consequently increase the effective head on the particular ones that start to work first. To eliminate this possibility it is necessary that each aërator shall contain sufficient resistance to prevent a few of them from discharging all the air that is intended to be discharged by the entire system. In other words, a certain resistance to the flow of air is absolutely necessary to insure a uniform distribution. Where the tank is 10 ft. in depth, this resistance should be such that a net head of at least 6 in. of water is required to discharge the amount of air that the aërating plate is designed to provide. If a type of aërator were used that did not require a 6-in. hydrostatic head to discharge the required amount of air, some other resistance would have to be used at each aërator; consequently the resistance offered by the filtros plate is of no disadvantage until it becomes greater than 6 in. It is believed that a proper filtros plate can be selected for any particular design that will afford the right resistance to insure uniform distribution, but it is necessary that air should be freed of all dust and that the tank should be worked as a continuous-flow tank or the resistance of the filtros plate will gradually increase with a resultant loss of power.

### Armour & Co., Chicago: G. L. Noble*

The filtros plates that we had in our tank were admitted by the General Filtration Co. to be of uneven porosity, due to the manufacture by an outside kiln firm. This resulted in the very rapid clogging of the finer plates, and this method of distribution was abandoned.

Perforated pipes were promptly installed and have given good satisfaction. They are made of ¾-in. galvanized iron and perforated with $^1/_{25}$-in. holes, 2 in. apart and staggered. Cleaning is necessary only once in four months, and this cleaning can be accomplished in short order without interfering with the operation of the plant.

We have carefully studied all the data available for comparing these two methods and have yet to be convinced that a porous plate is preferable to perforated pipe, when the matter is considered from every viewpoint. We expect (July 3) to install perforated pipes in our larger experimental plants.

### Cleveland, Ohio: R. Winthrop Pratt†

We have been running now (July 3) more than five months and as yet have noticed no trouble which might be due to clogging of filtros blocks.

We hope and believe that with our type of blower, containing as it does a water trap through which the air must go, there will be no serious trouble from dirt or dust in the air entering the activated-sludge tanks.

### Illinois Water Survey: Edward Bartow‡

In our experiments, operating tanks on the fill-and-draw plan for about a year, we have experienced no trouble from clogging of the filtros plates. On the fill-and-draw plan, however, the pores are cleaned by downward flow of the water while the air is shut off during the settling period.

In our continuous-flow plant, about to be put in operation, we expect to filter the air through cheesecloth, and we have made arrangements so that the air may be shut off and water allowed to flow downward through the plates into a space from which it can be pumped. We can tell better after operating whether our precautions are satisfactory, but we do not anticipate any trouble from clogging of plates by impure air.

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†Consulting Engineer, Department of Public Service, Cleveland, Ohio.

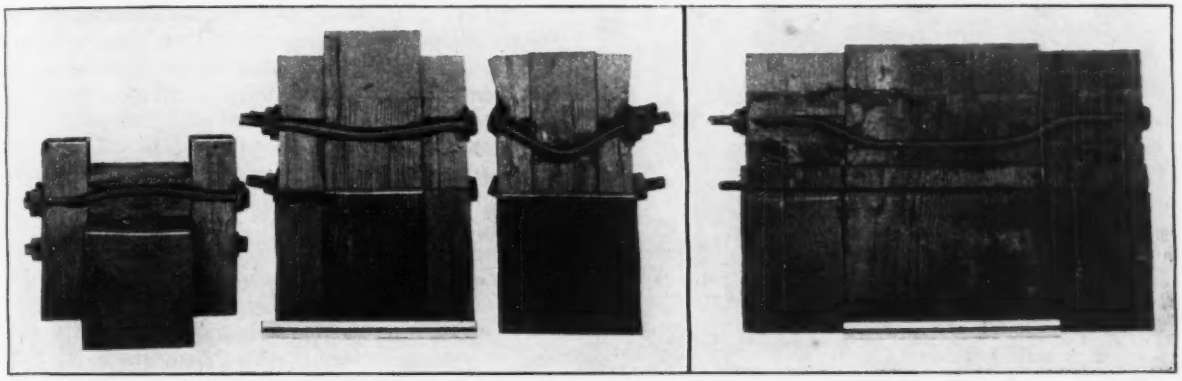
‡Director, State Water Survey, Urbana, Ill.

# New Tests of Bolted Joints in Timber Framing

By H. D. Dewell*

*SYNOPSIS—New tests on bolted joints in timber give a safe basis for design. Previous rules of handbooks are unreliable. A 7/8-in. bolt in double shear is good for 2,000 to 2,850 lb., depending on the thickness of the timber and pads; in single shear, half as much.*

In an article entitled "Tests of Some Joints Used in Heavy Timber Framing," *Engineering News*, Mar. 19 and 26, 1914, the author discussed briefly the lack of definite knowledge of the actual strength of bolted timber joints and the discrepancy between the sizes of bolts in such connections, as computed by the accepted methods of design, and those sizes commonly used by contractors and architects. There were presented the results of some tests made by E. E. Adams on 2-in. plank bolted with ½-in., 5/8-in. and ¾-in. bolts, and reference was made to other tests on bolted end joints of timber trusses. These are the only recorded tests of bolted joints which the author has been able to find.



Joint 11—Side bearing 2¾x6-in. pads on 6-in. timber; three ¾-in. bolts; maximum load, 35,000 lb.; deflection, 0.735 in.

Joint 6—End bearing 2⅞x8-in. pads on 6x8-in. timber; three ¾-in. bolts; maximum load, 36,250 lb.; deflection, 0.635 in.

Joint 3—End bearing 2x8-in. pads on 4x8-in. timber; three ¾-in. bolts; maximum load, 46,650 lb.; deflection, 1.95 in.

Joint 20—End bearing 6x10-in. pads on 12x10-in. timber; three ⅝-in. bolts; maximum load, 46,325 lb.

All of these joints show the pronounced bending of the bolts under compression of the timber.

FIG. 1. FOUR OF THE BOLTED JOINTS CUT OPEN AFTER TEST

The same article also described some tests by the author to determine the lateral resistance of ¾x4½-in. lag screws used to fasten 2-in. timber plates, as in column lacing or bracing. Here again is a field in which no other tests have been recorded, to the author's knowledge.

## A New Series of Tests

For fuller information a further series of tests was made during 1915. This series comprised tests of 24 bolted joints, 10 all-timber lagscrewed joints, 4 joints in which a steel plate was lagged to timbers with ¾-in. and ⅞-in. lagscrews, and 13 tests made to determine the bearing resistance of a round bolt against the ends and across the fibers of Douglas fir. The joints were tested at the Panama-Pacific International Exposition, in the Palace of Machinery, on an exhibit testing machine of Tinius Olsen & Co., of Philadelphia. The machine is of 150,000 lb. capacity, with an attachment for making autographic records of the tests and a device for automatically balancing the arm by means of a sliding weight.

The tests on lagscrewed joints are dealt with in a subsequent article.

## Present Methods of Designing Bolted Joints

One of the most difficult things an engineer has to contend with in timber design is the justification of the large size of bolts, when designed as pins, as compared with the sizes found in the designs made by many contractors and architects. In checking over many plans the author has found it to be a common practice to consider bolts in timber joints as equivalent to rivets in steel joints. Obviously, this practice is vitally wrong in principle. Shear usually governs the design of rivets or bolts in steel connections, but in timber joints the bolts will bend or the timber fail before the bolt will fail in shear.

Not alone are these high values used for bolts having all end bearing against the timber, but they are also used when the bolts have partial or entire bearing across the fibers of the timber. A common example of a connection in which the bolts bear across the fibers is that of an all-timber truss, where the web members consist, say, of 2-in. plank bolted to the chords. In such a case strict adherence to the method of designing the bolts as pins, with due allowance for bearing across the fibers, results in bolts of abnormal size, and the engineer is criticized for extravagance.

The rules given by text-books vary over a large range. As concerns designing bolts as rivets, Kidder ("Architects' and Builders' Pocket Book") disregards bending where the pieces joined are not more than 2 in. thick. W. J. Douglas (in Merriman's "American Civil Engineers' Pocket Book") disregards bending where the pieces are less than 3 in. thick. For computing bending in bolts, the rules given are as follows:

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Considering a butt joint of two sticks 2L thick, spliced on each side by a pad L thick, through-bolted, the joint carrying a load 2P, of which half goes through each pad: Kidder gives the bending movement in the bolts as $\frac{1}{4}$PL; Jacoby ("Structural Details") gives it as $\frac{1}{2}$PL, on the assumption of uniform pressure on the bolt; Howe

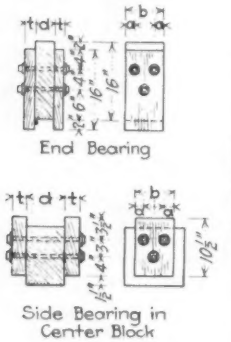


TABLE OF DIMENSIONS

| | Joint | Bolts, In. | t In. | d In. | a In. | b In. |
|---|---|---|---|---|---|---|
| End Bearing | 1 | ¾ | 2 | 4 | 2½ | 8 |
| | 2 | ⅝ | 2 | 4 | 2½ | 8 |
| | 3 | ¾ | 2 | 4 | 2½ | 8 |
| | 4 | ¾ | 2¾ | 5¾ | 2½ | 8 |
| | 5 | ⅝ | 2 | 4 | 2½ | 8 |
| | 6 | ¾ | 2⅞ | 6 | 2½ | 8 |
| | 10 | ¾ | 4 | 8 | 2½ | 8 |
| | 14 | ⅝ | 3⅞ | 8 | 2½ | 8 |
| | 15 | ⅝ | 3¾ | 8 | 2½ | 8 |
| | 16 | ¾ | 3⅞ | 8 | 2½ | 8 |
| | 18 | ¾ | 6 | 12 | 2½ | 10 |
| | 19 | ⅝ | 6 | 12 | 2½ | 10 |
| | 20 | ⅝ | 6 | 12 | 2½ | 10 |
| | 21 | ⅞ | 6 | 12 | 2½ | 10 |
| | 22 | 1 | 6 | 12 | 2½ | 10 |
| | 23 | 1 | 6 | 12 | 2½ | 10 |
| | 24 | ¾ | 6 | 12 | 2½ | 10 |
| | 25 | ⅞ | 6 | 12 | 2½ | 10 |
| | 27 | ⅞ | 5⅞ | 12 | 2½ | 10 |
| | 28 | ⅞ | 5¾ | 12 | 2½ | 10 |
| Side Bearing | 11 | ¾ | 2¾ | 6 | 2½ | 6 |
| | 12 | ¾ | 4 | 8 | 2½ | 6 |
| | 13 | ¾ | 4 | 8 | 2½ | 6 |
| | 26 | ¾ | 2⅞ | 6 | 2½ | 6 |

FIG. 2. DETAILS OF BOLTED TEST JOINTS

("Treatise on Wood Trusses") uses the same formula as Jacoby; W. J. Douglas uses the same formula as Kidder; Thayer ("Structural Design," Vol. I) recommends assuming uniform bolt pressure on such a length of bolt that the resulting bending in the bolt will just equal the flexural or shearing strength of the bolt. Not only the formulas but also the stresses used by these several authors differ.

Table 1 gives the working strengths of the joints as determined by the methods of Jacoby, Howe, Kidder, Merriman and Thayer, together with results deduced from the new tests. In the case of all the authorities the lowest and highest values are shown—that is, the values for joints with 2-in. and 2⅞-in. splice pads and those with 6-in. splice pads. This table emphasizes the wide variation in the prescribed practice of designing bolts.

The author maintains that the high values as given for joints with the thin plates, when based on the supposition of friction, cannot be sustained, as shrinkage of the timber will soon destroy the effect of friction.

### Joints Tested After Loosening Nuts

Fig. 2 shows details of the joints tested. All had three bolts; 20 had the bolts bearing against the ends of the fibers, while 4 had the bolts bearing against the sides of the fibers of the main timber. The washers throughout were standard cut pressed-steel washers.

All joints were tested in compression. Before commencing the tests all nuts were loosened so that friction should not play a part in the results. This was to approximate the condition of a joint after shrinkage has taken place—a condition which actually exists in the majority of cases. An initial load of 1,000 lb. was first put on the joint, and the autograph set at 1,000 lb. load and zero deflection.

As to the propriety of loosening the nuts in the test specimens: The test conditions were considerably simplified by eliminating the influence of the washers; the action of the bolts was thus limited to bearing and bending, and a rational analysis of the results was made possible. But the practical side of the matter is even more important. Even with washers tight it is not probable that friction plays a very important part in the action of a bolted joint as ordinarily framed. The washers are usually of such a small size that when the nuts are tightened the washers sink into the timber instead of pulling the pieces of timber together. However, if comparatively large washers are used, considerable friction will certainly exist.

In addition, and much more important, the washers will exert a restraining moment on the bolt, tending to produce the condition in the bolt of a restrained beam, and the larger the washer the more effective is its action. However, unless the washers are at all times tightly drawn against the wood this action will not exist. Thus, if any appreciable shrinkage takes place, the washers will not bear tightly, and the bolt will deflect before the washer takes up.

In other words, the strengthening effect of the washers is not available at the working values of the joint where shrinkage can take place. And with green timber it does not take the sun long to shrink the timber, even in temporary construction, as contractors' falsework.

In joints 2 to 6 and 10 to 16 inclusive the slip of the side pieces over the center piece was measured by graduated cards tacked on the two lines of division of one face only. In joints 18 to 28 inclusive the slip was measured by means of two threads stretched across each face and passing over two graduated cards, one on the center of each exposed face of the center block.

The load-slip curves made by the pencil of the autograph show, in all cases but one, more deflection than those plotted from the direct readings. This is due to the fact that the autograph measures the total movement

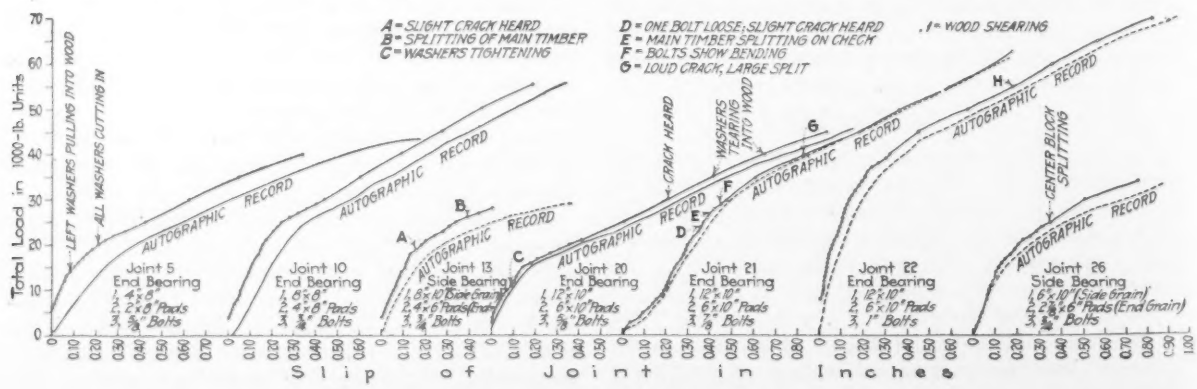
Total Load in 1000-lb. Units
Slip of Joint in Inches
A = SLIGHT CRACK HEARD
B = SPLITTING OF MAIN TIMBER
C = WASHERS TIGHTENING
D = ONE BOLT LOOSE; SLIGHT CRACK HEARD
E = MAIN TIMBER SPLITTING ON CHECK
F = BOLTS SHOW BENDING
G = LOUD CRACK; LARGE SPLIT
H = WOOD SHEARING
LEFT WASHERS PULLING INTO WOOD
ALL WASHERS CUTTING IN
CRACK HEARD
WASHERS TEARING INTO WOOD
CENTER BLOCK SPLITTING
AUTOGRAPHIC RECORD
Joint 5 End Bearing 1-4"x8" 2-2½"x8" Pads 3-⅝" Bolts
Joint 10 End Bearing 1-6"x8" 2-4"x8" Pads 3-⅜" Bolts
Joint 13 Side Bearing 1-6"x10" Side Grain 2-4"x6" Pads End Grain 3-⅜" Bolts
Joint 20 End Bearing 1-12"x10" 2-6"x10" Pads 3-⅝" Bolts
Joint 21 End Bearing 1-12"x10" 2-6"x10" Pads 3-⅞" Bolts
Joint 22 End Bearing 1-12"x10" 2-6"x10" Pads 3-1" Bolts
Joint 26 Side Bearing 1-6"x10" (Side Grain) 2-2⅜"x6" Pads (End Grain) 3-⅝" Bolts

FIG. 3. TYPICAL LOAD-SLIP CURVES OF BOLTED JOINTS

TABLE 1. COMPARISON OF STRENGTH OF TEST JOINTS AT SAFE WORKING STRESSES

| Item | Authority | 2-In. Side Timbers, 4-In. Center Timbers | | | | 2½-In. Side Timbers, 5½-In. Center Timbers | | | | 6-In. Side Timbers, 12-In. Center Timbers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3-¾ In. B | 3-1 In. B | 3-1¼ In. B | 3-1½ In. B | 3-¾ In. B | 3-1 In. B | 3-1¼ In. B | 3-1½ In. B | 3-¾ In. B | 3-1 In. B | 3-1¼ In. B | 3-1½ In. B |
| 1 | Merriman* (W. J. Douglas) | 9,000 | 10,800 | 12,600 | 14,400 | 12,937 | 15,675 | 18,112 | 20,700 | 1,080 | 1,860 | 2,960 | 4,410 |
| 2 | Howe† | 1,793 | 3,100 | 4,920 | 7,350 | 1,248 | 2,160 | 3,420 | 5,110 | 598 | 1,030 | 1,640 | 2,450 |
| 3 | Kidder‡ | 10,125 | 12,144 | 14,196 | 16,200 | 2,590 | 4,460 | 7,100 | 10,600 | 1,080 | 1,860 | 2,960 | 4,410 |
| 4 | Thayer§ | 3,330 | 4,800 | 6,540 | 8,850 | 3,330 | 4,800 | 6,540 | 8,850 | 3,330 | 4,800 | 6,540 | 8,850 |
| 5 | Jacoby‖ | 1,620 | 2,740 | 4,400 | 6,615 | 1,295 | 2,230 | 3,555 | 5,300 | 540 | 930 | 1,480 | 2,205 |
| 6 | Test curves** | 4,250 | 5,000 | .... | .... | 4,250 | 5,000 | .... | .... | 4,250 | 5,000 | 6,750 | 9,500 |
| 7 | Test curves†† | 5,500 | 6,500 | .... | .... | 5,500 | 6,500 | .... | .... | 5,500 | 6,500 | 9,000 | 12,500 |
| 8 | Formula | 3,171‡‡ | 4,350‡‡ | 5,700‡‡ | 7,380‡‡ | 3,747‡‡ | 4,920‡‡ | 6,255‡‡ | 7,890‡‡ | 4,388 | 6,300 | 8,550 | 11,115 |
| 9 | Proposed working values | 4,800 | 5,250 | 6,150 | 7,050 | .... | .... | .... | .... | 4,350 | 6,300 | 8,550 | 11,115 |

* Bearing pressure 1,200 lb. per sq.in., stress in bolts 22,500 lb. per sq.in. † Bearing pressure 650 lb. per sq.in., stress in bolts 25,000 lb. per sq.in. ‡ Bearing pressure 1,350 lb. per sq.in., stress in bolts 22,500 lb. per sq.in., stress in bolts 25,000 lb. per sq.in. § Bearing pressure 1,250 lb. per sq.in., stress in bolts 16,000 lb. per sq.in. ‖ Bearing pressure 1,080 lb. per sq.in., stress in bolts 22,500 lb. per sq.in. ** Values = ¼ loads when Δ = 0.0625 in. †† Values = loads when Δ = 0.025 in. ‡‡ Values for M = RPl, where R varies from ¼ to $\frac{1}{27}$.

Values of t, for S = 16,000 lb. per sq.in., B = 1,300 lb. per sq.in., by formula $t = d\left(\frac{\pi S}{32B}\right)^{\frac{1}{2}}$ are: d = ¾ in., t = 3.6 in., joint strength = 4,388 lb.; d = ¾ in., = 4.3 in., joint strength = 6,289 lb.; d = ¼ in., t = 5.0 in., joint strength = 8,531 lb.; d = 1 in., t = 5.7 in., joint strength = 11,115 lb.

of the head of the testing machine, and its curve includes any crushing of the timber. All the timbers were cut off by a circular saw and the ends left unfinished, so that an initial deflection resulted from crushing of the softer fibers.

The ends of all joints were not exactly square. If badly out, they were shimmed with cards or thin metal plates. In all cases they came to full bearing upon the application of a few thousand pounds of load.

The instructions issued to the carpenters framing the joints were to make a good workmanlike job, all cuts to be true and square and all bolts to be a driving fit. In the tests of joints 21 and 25 the deflections indicated the bolts were not a driving fit. Consequently, two additional joints were made and tested. Since the large initial deflection noted in the previous joints did not materialize, this result justified the conclusion of loose bolts in the original joints.

## Discussion of Tests

Table 2 gives a summary of the principal figures obtained in the tests. The curves of the test results show a more or less definite break at a load approximately one-third the ultimate strength. Specimen curves are given in Fig. 3. Not all of the joints were tested to failure, the idea being to carry the test well past the break in the curve. By the aid of the autograph this point could be determined as the test proceeded. In some of the joints this break is very marked, and the portion of the curve below is practically a straight line.

The load at this break was, for most joints, taken as the "apparent yield point" of Table 2. Where a curve had no well-defined break, the J. B. Johnson method of finding a point having 50% greater value of deformation than the initial was employed to find the apparent elastic limit.

That practical use may be made of the results of the tests, it at once becomes imperative to determine what point on the curves shall be considered the critical point —that is, the critical load on which to base the factor of safety and the working load. In this respect the ultimate load the joint will carry is of small moment, since the slip is so great. The loads at first appreciable slip might be taken as the critical point and the working load based on this value. This would be on the safe side, but it seems extravagant to use a working load of only one-tenth the ultimate strength.

In the case of nailed joints it has been found that the elastic limit of the joint corresponds to a slip of about $\frac{1}{16}$ in. or $\frac{5}{64}$ in., and the working loads are taken at one-third to three-fifths of the loads corresponding to this slip.[1] Would it not be reasonable then to establish in the

TABLE 2. SUMMARY OF TEST. RESULTS ON BOLTED JOINTS, 1915 TESTS

| Joint No. | Number and Size of Bolts No. | In. | Thickness of Side Pcs., In. | Center Piece, In. | Load at Apparent Yield Pt.[4] Lb. | Load at Slip of 1/16 In., Lb. | Final Load[3] Lb. | Final Slip, In. | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | ¾ | 2 | 4 | [1] | [1] | 42,000 | 2.00 | No slips |
| [2]2 | 3 | ¾ | 2 | 4 | 16,000 | 6,500 | 41,000 | 1.85 | Measured |
| 3 | 3 | ¾ | 2 | 4 | 12,500 | 7,000 | 45,000 | 1.95 | |
| 4 | 3 | ¾ | 2½ | 5½ | 11,000 | 8,000 | 45,000 | 1.15 | |
| 5 | 3 | ¾ | 2 | 4 | 13,000 | 5,000 | 43,500 | 1.68 | |
| 6 | 3 | ¾ | 2½ | 6 | 10,000 | 6,500 | 36,250 | 0.64 | |
| 10 | 3 | ¾ | 4 | 8 | 15,000 | 6,000 | 55,000 | 1.39 | |
| [5]11 | 3 | ¾ | 2½ | 6 | 11,000 | 7,500 | 35,000 | 0.73 | Ultimate |
| [5]12 | 3 | ¾ | 4 | 8 | 14,000 | 10,500 | 23,000 | 0.53 | |
| [5]13 | 3 | ¾ | 4 | 8 | 15,000 | 10,500 | 29,000 | 0.52 | Ultimate |
| 14 | 3 | ¾ | 3½ | 8 | 13,000 | 7,000 | 27,000 | 0.72 | |
| 15 | 3 | ¾ | 3½ | 8 | 13,000 | 6,500 | 20,000 | 0.47 | |
| [5]16 | 3 | ¾ | 3½ | 8 | 15,000 | 4,000 | 28,000 | 0.58 | |
| 18 | 3 | ¾ | 6 | 12 | 13,000 | 7,000 | 60,000 | 1.64 | |
| 19 | 3 | ¾ | 6 | 12 | 14,000 | 7,500 | 30,000 | 0.83 | |
| 20 | 3 | ¾ | 6 | 12 | 15,000 | 9,500 | 46,000 | 1.64 | |
| [5]21 | 3 | ¾ | 6 | 12 | 18,000 | 3,500 | 63,000 | 1.78 | |
| 22 | 3 | 1 | 6 | 12 | 26,000 | 20,000 | 70,000 | 1.53 | |
| 23 | 3 | 1 | 6 | 12 | 27,000 | 16,500 | 75,000 | 1.78 | |
| 24 | 3 | ¾ | 6 | 12 | 16,000 | 10,500 | 45,000 | 1.28 | |
| [5]25 | 3 | ¾ | 6 | 12 | 23,000 | 2,000 | 60,000 | 1.46 | |
| [5]26 | 3 | ¾ | 2½ | 6 | 15,000 | 8,000 | 34,000 | 0.63 | Ultimate |
| 27 | 3 | ¾ | 5½ | 12 | 22,000 | 12,500 | 60,000 | 1.54 | |
| 28 | 3 | ¾ | 5½ | 12 | 21,000 | 13,500 | 60,000 | 1.26 | |

[1] No slips except the final made on Joint No. 1.
[2] In Joints 1 to 16 direct readings were made on one side of joint only, and probably direct-reading curves do not indicate true slips of joints. In these joints there is a large difference between direct-reading curves and autographic curves.
[3] The final loads are not necessarily ultimate loads.
[4] Bolts bearing across the fibers of the center timber.
[5] Large initial deflection, probably due to loose fit of the bolts in the timber.
[6] The average slip of the joints at the loads under the heading "Load at Apparent Yield Point" was 0.12 in. Using the formula developed in the text, the unit flexural stress in the bolts for this load is approximately 35,000 lb. per sq.in.

[1] Three sets of tests on the strength of nailed joints when subjected to lateral forces are on record. The first set was made by Walker and Cross in 1897 at the University of Minnesota. The results are published in the "Journal" of the Association of Engineering Societies, Vol. 19, December, 1897, by A. W. Muenster. The second set was made by Darrow and Buchanan at Purdue University in 1898-99 and presented to the Indiana Engineering Society by Prof. W. K. Hatt, being published in the 1900 "Proceedings" of that society. An abstract and review of both these sets of tests are given in Jacoby's "Structural Details." The third series of sets was made in 1907 by Morgan and Marish at the Iowa State College, and the results were recorded by M. I. Evinger in Bulletin 2, Vol. IV, of the engineering experiment station of the Iowa State College, under the title of "Holding Power of Nails in Single Shear."

From these tests it was found that the elastic limit of the joints corresponded to a slip of about $\frac{1}{16}$ in. The first and second series of tests showed this elastic limit to be at a load approximately 16 times the penny designation of the nail, or E.L. = 16 D. The load at the elastic limit of the joints in the tests of Darrow and Buchanan was found to be approximately 29 D, or almost twice that of the other two tests.

Professor Hatt recommends a working load of about ⅓ the ultimate, or ½ the elastic limit, W.L. = 9.5 D, while Mr. Muenster advocates a working value of 60% of the elastic limit.

The foregoing tests comprise joints of white pine, spruce, yellow pine and oak. It was found that while the different timbers give varying results, in accordance with their different strengths to resist compression against the ends of the fibers, the variation is not in direct proportion to these values. It was also found that changing the direction of the cleats in the joints so that the bearing of the nails was across the fibers apparently made no difference in the strength of the joint.

The author has studied the discussions and records of the tests on nailed joints as given in detail in the original papers, and is convinced of the truth of the following conjectures:

1. The erratic load-deflection curves are largely the result of the rough methods used in determining the slips, the true average slip of the joint apparently not having been found.

2. The lack of agreement between the ratio of the strengths of two similar joints of different timbers and the ratio of the unit compression strengths of the respective timbers was to have been expected, since the resistance of timber to the pressure of a metal cylinder in a tight-fitting hole is not the same as where such pressure is applied on a flat surface.

case of the bolted joints a working load of 50% of the load corresponding to a slip of $\frac{1}{16}$ in., or possibly a working load corresponding to a slip of 0.03 in.?

In order to study the tests more fully several of the joints were cut open (Fig. 1 reproduces four of them).

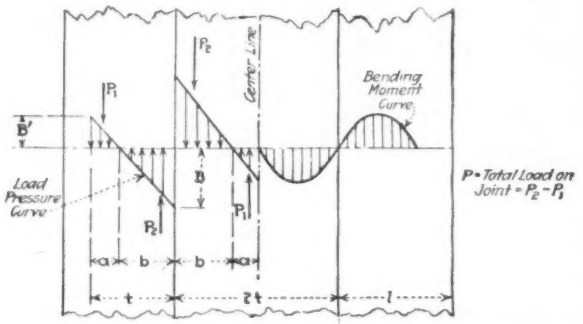


FIG. 4. DIAGRAM OF BOLT PRESSURES AND MOMENTS

These joints exhibit some exceedingly interesting features. It is evident that the bolts acted as restrained beams with reflex bending, the two points of contraflexure being on the contact surfaces of the main timber and side pieces. This condition of restraint was furnished in two ways—first, by the distribution of loading and, second, by the action of the washers.

From a study of the condition of the bolts after bending, the following theory of the distribution of load on the bolts is proposed:

Let

$S$ = Maximum allowable flexural stress in the bolt;
$B$ = Maximum allowable bearing stress against the ends of fibers of timber;
$d$ = Width of timber and splice pads;
$2t$ = Thickness of main timber;
$a$, $b$, $B'$, $P_1$, $P_2$ as shown.

It will be assumed that the distribution of load on the bolt, as shown in Fig. 4, is triangular, concentrated near the contact surfaces and of such arrangement as to produce the condition of a restrained beam with point of contraflexure at each contact surface. In order to conform to these conditions, $b$ must equal $2a$; then $B' = \frac{1}{2} B$.

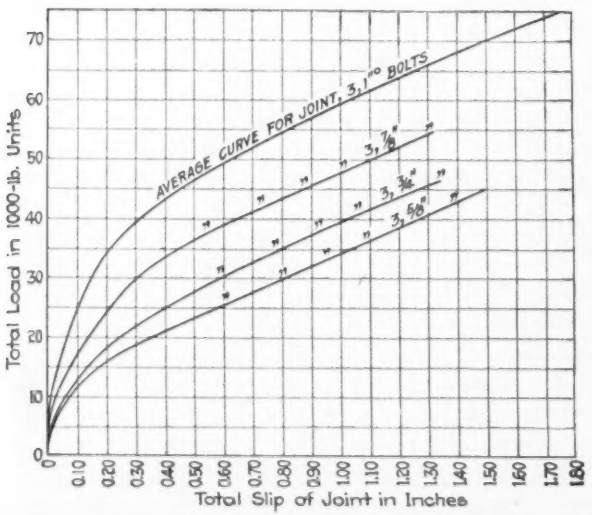


FIG. 5. PROPOSED AVERAGE LOAD-SLIP CURVES FOR FOUR SIZES OF BOLT

The distribution of bending moment will be as shown, there being two equal maximum moments, of amount $M = \frac{2}{27} Pl$, where $l = a + b$, and of course $t$ must be not greater than $l$.

Under the assumption that beyond a certain minimum value of $t$, or thickness of side piece, the strength of the joint is independent of the length of bolt required, it is possible to find the length $t$ such that the moment resulting from the load on this length of bolt will just equal the flexural strength of the bolt.

With the safe stresses for flexure of bolts and bearing for the timber, the strength of the bolts is easily determined; and for all thicknesses of side pieces in excess of the limiting value $t$ the strength will be constant. For thicknesses of side pieces under $t$ the safe strength of the bolts will be a question of bearing against the timber (assuming the pressure distribution to remain constant) with a resultant decrease in the strength of the joint. The results of the tests do not bear out this assumption. It is believed that in joints where the thickness of side timbers is less than the limiting value $t$, the pressure-distribution diagram, while holding to the general triangular shape, changes in its relative dimensions $a$ and $b$, within the limits where $a = 0$ and $a = \frac{1}{3}$. Further, it is held that the ratio of $a$ to $l$ is always such that the resulting bending moment on the bolt bears the same relation to the capacity of the bolt in bending as the maximum intensity of pressure on the timber bears to the resistance of the timber in bearing.

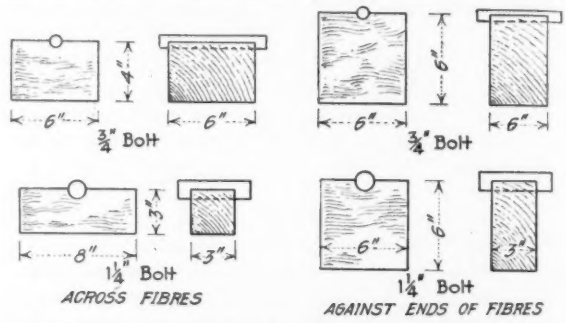


FIG. 6. DETAILS OF BOLT-BEARING TEST PIECES

Following out these assumptions, the strengths of the test joints with 2-in., 2⅞-in. and 6-in. side timbers have been calculated, using 16,000 lb. per sq.in. as the flexural stress in the bolts and 1,300 lb. per sq.in. as the limiting pressure on the timber. The results are entered in item 8 of Table 1, and are seen to coincide approximately with the values taken from the test curves as shown in item 6.

A careful study of the different curves has led to the conclusion that for all the test joints having the same diameter of bolts—except joints 11, 12, 13 and 26, in which the bolts bear across the fibers of the center timber—the load-slip curve is practically a constant. Expressed in another way: For the limits of the tests the strength of the joints with ⅝-in. and ¾-in. bolts is nearly independent of the thickness of timber.

Fig. 5 shows curves representing the relation between deformation and stress for each size of bolt.

### Side-Bearing Joints as Strong as End-Bearing

For those joints where the bolts have bearing across the grain of the center timber (joints 11, 12, 13 and 26) the stress-deformation curves appear to coincide with those for end-bearing joints up to loads of about 30,000

lb., or 5,000 lb. per bolt. For working loads, therefore, the resistance of these joints is apparently as great as those having all end bearing.

The author has been unable to find any treatment of the subject of the pressure of a bolt against the fibers and across the fibers of timber which would explain the relatively large strength of the test joints having cross-bearing on the timber.

Where a cylindrical pin bears across the fibers of timber in a closely fitting hole, as occurs in the case of a bolt with a driving fit, it is unquestionably true that the various differential surfaces of the timber along the perimeter of the hole exert pressures against the pin and that these pressures bear some relation to the safe compressive resistance of timber surfaces inclined to the direction of the fibers. Consequently, the total pressure exerted by the timber on the pin may be taken at a value greater than that obtained by multiplying the diametral section of the pin by the safe compressive strength of the timber in cross-bearing.

A tentative theoretical consideration of this problem leads the author to believe that the unit stress for the average pressure on the diametral section of the pin, in side bearing, may be taken as high as 800 lb. per sq.in. Similarly, for bearing against the ends of the fibers of the timber a diametral pressure of 1,300 lb. is allowable, if the ordinary end-bearing and side-bearing strengths of timber (on *plane* surfaces) are 1,800 and 300 lb. respectively. The formula derived is $p = \frac{2}{3}\ S' + \frac{1}{3}\ S''$, where $S'$ and $S''$ are the ordinary bearing strengths and $p$ is the allowable pressure of a pin in the direction of $S'$.

### Tests of Bolts in Bearing on Wood

In an effort to determine the relative resistance of bolts bearing against and across the fibers of timber a number of small blocks was made with half-holes and was tested each with a short piece of bolt having a tight fit in the hole, as per detail Fig. 6. The results were somewhat disappointing. While the stress-deformation curves for the two sizes of bolts bearing across the fibers are practically constant, there is a wide variation in the curves for end bearing, although the ultimate strengths are practically the same. It should be stated that the blocks with the 1¼-in. bolts were much better specimens, both in respect to quality of timber and grade of workmanship, than those with the ¾-in. holes, the latter having untrue end cuts. However, all uneven blocks were shimmed up, and it is not likely that the difference in strength shown was due altogether either to quality of timber or to workmanship (Fig. 7.)

On the basis of a limiting joint-deformation of 0.03 in. the safe bearing pressures are seen to be, in the case of 1¼-in. bolts, 2,000 lb. per sq.in. along the grain and 525 lb. per sq.in. across the grain. For the ¾-in. bolts the corresponding values are 1,500 lb. and 900 lb. per sq.in.

### Conclusions

The author believes that the following conclusions and recommendations for working data, made from a careful study of the tests, are justifiable and reasonably conservative.

1. For bolts with driving fit in the timbers the strength of the joint is practically independent of the thickness of the side pieces, when this thickness exceeds the limiting value "*t*."

2. While the ultimate strength of the joints whose bolts have cross-bearing in the main timber is far below that of the all-end-bearing joints, the stiffness of such joints up to the break in the curve is practically the same.

3. The safe loads for bolts in joints like those described, having all end bearing, may be taken as per Table 3. These values correspond fairly well to one-half the loads for $\frac{1}{16}$-in. slip. These working loads are consistent with the results of tests on nailed joints.

4. For the allowable pin pressure it is proposed that for Douglas fir and similiar timbers 800 lb. per sq.in. be used for cross-bearing and 1,300 lb. per sq.in. for end bearing.

5. For connections in which the bolts are in single shear only, as in the case of two timbers bolted together, it is

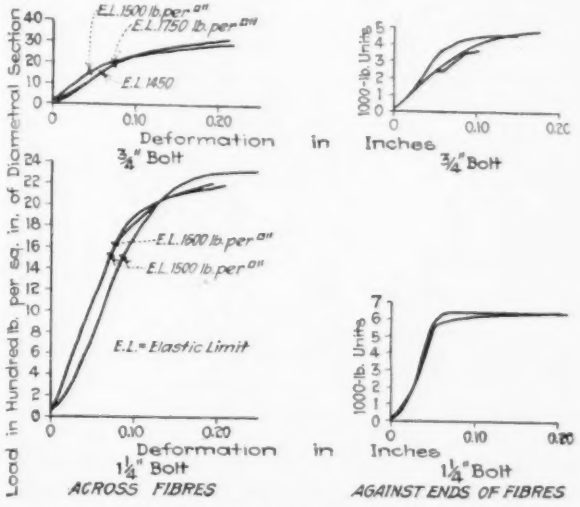


FIG. 7. LOAD-DEFORMATION CURVES FOR BEARING TESTS

recommended that the value of the bolts be taken at one half the values given in Table 3.

6. For connections in which the bolts bear across the fibers of the timber, it is recommended that the values of

TABLE 3. WORKING STRENGTH OF ONE BOLT IN TIMBER JOINT (BOLT IN DOUBLE SHEAR)

For Joints Similar to Test Joints, with Bolts Bearing Against End of Grain

| Size of Bolt, In. | Thickness of Side Pieces and One-Half Thickness of Center Timber | | | |
|---|---|---|---|---|
| | 2 In. | 3 In. | 4 In. | 6 In. |
| ¾ | 1,057 | 1,275 | 1,460 | 1,460 |
| 1 | 1,450 | 1,665 | 1,980 | 2,100 |
| 1¼ | 1,900 | 2,130 | 2,450 | 2,850 |
| 1½ | 2,460 | 2,664 | 2,960 | 3,705 |

These values are for double shear. For single shear take one-half the tabular values.

the bolts be taken at six-tenths the values given for all end bearing.

7. The working values recommended are for Douglas fir. For other timbers these values are to be multiplied by the factors following:

| | |
|---|---|
| Long-leaf yellow pine | 1.05 |
| White pine | .78 |
| Norway pine | .65 |
| White oak | .78 |

8. All working values herein given are for timber in a dry condition, as for use in the interior of buildings.

**Purchase of the Garbage-Reduction Works** of the Genesee Reduction Co. is proposed by the City of Rochester, N. Y., the plant to be taken over on Jan. 1, 1917. The price would be fixed by a commission of three, chosen in the usual manner. Herbert W. Pierce is commissioner of public works and Edwin A. Fisher is consulting city engineer.

# Engineering Literature

## Eleven Worthy Volumes

The International Engineering Congress held last September at San Francisco was made possible through a guarantee fund provided by five great national engineering societies. Although the international feature was unfortunately curtailed, the congress was a success, as is attested by the high character of the eleven volumes of "Transactions" now published. These volumes are being distributed to advance subscribers, and only a few copies may be had by anyone else. In fact, Vol. III, "Municipal Engineering," and Vol. V, on "The Materials of Engineering Construction," are already out of print, while of Vol. IV, "Railways and Railway Engineering," and Vol. VIII, "Mining Engineering," only ten copies each remain. Of Vol. II, "Waterways and Irrigation," however, which was without doubt one of the most valuable and important sections of the congress, about 90 copies are still available. (Address International Engineering Congress, Foxcroft Building, San Francisco, Cal.; $5 per volume in paper, or $5.50 in cloth.)

It is only giving credit where credit is due to say that the success of the Engineering Congress and the value of its "Transactions" as a contribution to technical literature are the result, first of all, of the untiring energy of San Francisco engineers, who bore the prime responsibility. To Prof. W. F. Durand, Chairman of the congress, and W. A. Cattell, Secretary and Treasurer, the thanks of the profession are certainly due for the efficient manner in which they have carried out their tasks.

# REVIEWS AND NOTES

## New Ideas in Teaching Text on Elementary Hydraulics

REVIEWED BY ROBERT E. HORTON*

HYDRAULICS—By R. L. Daugherty, Assistant Professor of Hydraulics, Sibley College, Cornell University. New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xiv + 267; 243 illustrations. $2.50 net.

This work is intended primarily as a textbook for use in engineering schools, where the time that may be devoted to hydraulics proper, aside from its applications, is rather limited. The subject matter has accordingly been thoroughly generalized. Few working data are given. Those which do appear in the book include coefficients for orifices of certain forms, coefficients of roughness and values of $C$ in Kutter's formula. These are evidently intended as a basis for the solution of illustrative examples. The book wisely was not intended to be a working treatise for engineers, for in fact it is becoming increasingly difficult to incorporate in one book both a good practical treatise and a satisfactory teaching text. However, the simplicity and clearness of the author's statements of essential facts and principles of hydraulics are such that the book might well be read by many practicing engineers who have more or less hydraulic work to do, but have not specialized in this subject.

Many short demonstrations involving simple methods in integral calculus are given, but aside from these the text could all be readily understood by a student of high-school grade. It is not to be expected that such a course would prepare the student for active practical work; rather it should serve to pave the way for more advanced courses in special subjects. At the same time the author seems happily to have included a number of matters that the beginner in hydraulics needs to know early in his studies, but which are seldom explained even in more complete treatises.

Piezometers and differential gages are clearly and simply described. Pressure on curved surfaces—a subject often slighted in textbooks because it does not lend itself readily to elegance of mathematical treatment—is simply and quite fully treated.

The utility and limitations of the Kutter formula are well covered in a manner that rings true to the working engineer. There are many such practical subjects in hydraulics which for one reason or another get scant treatment in most engineering courses. When the graduate snubs up against one of these subjects in practice, he is likely to feel that there has been a serious gap somewhere in his training. This little book seems to go as far toward bridging these chasms as an elementary text can.

The author starts out with the dictum that students should get a better grasp on hydraulic phenomena as physical processes than they ordinarily obtain. In this the reviewer fully concurs. Unfortunately the physics of hydraulic phenomena, in the broader sense, seem to belong to the more advanced rather than to the elementary aspect of the subject. The beginner cannot be expected to grasp the physical intricacies of fluid friction, for example, as set forth by De Villamil. The book begins with a table of notation, which will add greatly to its value to the student after his course is finished, since he may pick up the text at almost any point and read it intelligently without searching for the meaning of symbols.

There are many halftone illustrations of hydraulic works, probably intended to convey to the student an impression of the practical and physical meaning of the subjects treated. This object would probably be better attained by the use of lantern slides in the lecture room. To the reviewer the pictures seem rather out of place. First, they afford an excuse—too often sought—for dilettante discussion among students in lieu of hard study; second, students should not need pleasing pictorial bait to induce them to study.

The descriptive chapters in relation to turbines and centrifugal pumps are popular in form and expression, capable of being readily understood by anyone. Some of the statements are, however, somewhat incomplete and a

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little unsatisfactory. For example, the reasons for the use of the simple inward-flow Francis-type turbine in some cases and inward-, downward- and outward-flow runners in other cases are not adequately set forth. The author virtually repeats a statement from his earlier "Hydraulic Turbines," that "modern inward-flow turbines are commonly known as Francis turbines in honor of James B. Francis, who built the first successful one in 1849."

Inasmuch as there has been considerable dispute regarding the relative merits and efficiencies of turbines of European and American designs, it would appear desirable that the facts regarding the development of the so-called Francis-type turbine should have been set forth somewhat more fully. In the first place, the inward-flow turbine in a commercially successful and fairly efficient form was invented and patented by Samuel B. Howd, of Geneva, N. Y. James B. Francis, as clearly set forth in his book, "Lowell Hydraulic Experiments," pages 61-62, credits Howd with the invention of the "center vent" waterwheel and adds:

> In the design of the Boott wheel, the author has so modified the form and arrangement of the whole as to produce a wheel essentially different from the Howd wheel as above described, although it may possibly be technically covered by the patent for that wheel.

So far as the reviewer knows, the term "Francis turbine" was first applied to what are more properly known in Europe as "mixed-flow turbines." Such wheels had been imported to France and Germany from America; and the Germans had learned the trick of modifying by calculation the design of the wheels so as to produce variation in speed and power, results which had in general only been obtained in this country by practical experiments. The wheel, which came to be known abroad as the Francis turbine, bore much less resemblance to the wheel made by Francis than did the Howd turbine. It was a pretty close copy of a design made by John B. McCormick.

Later, when the demand arose for specially designed turbines for use in America, European designers were generally called upon, there being no turbine designers then in this country. Their early designs for mixed-flow turbines consisted here, as abroad, in modification of methods of calculation of a fundamental form of runner, which was developed not by calculation at all, but purely by experiment; and since the turbine runners in this way had been misnamed Francis runners abroad, the misnomer was brought back to America.

Of course it is not to be expected in so brief a text that all such matters of detail will be fully entered into. However, the object of a textbook, it seems to be the reviewer, is that the student shall have a means of acquiring the spirit as well as the letter of the science, and this often involves somewhat more careful phraseology than seems to have been utilized in some of the more descriptive portions of this book. The author's plan is good, and it is to be hoped these few defects of execution will in another edition be carefully removed to perfect the work.

## Watson's Concrete Bridges

GENERAL SPECIFICATIONS FOR CONCRETE BRIDGES—By Wilbur J. Watson, M. Am. Soc. C. E. Third Edition. New York: McGraw-Hill Book Co. Paper; 8x11 in.; pp. 70; illustrated. $1 net.

The third edition of Wilbur J. Watson's "General Specifications for Concrete Bridges" brings that work up to January, 1916. It concludes some radical changes in the requirements, particularly as regards the quality of materials. Sections on surface finish and waterproofing have been completely rewritten.

## Principles of Depreciation

PRINCIPLES OF DEPRECIATION—By Earl A. Saliers, Ph. D., Instructor in Accounting and Investments, Yale University. New York: Ronald Press Co. Cloth; 6x9 in.; pp. 200; illustrated. $2.50 postpaid.

The many engineers in this country who have valuation work on their hands will find much to interest and enlighten them in Dr. Saliers' little treatise. Its value to them, first, will be its insistence on a sharp distinction between capital and revenue—matters of economics and accounting in which the engineer's training is limited. Its second value will be the closer acquaintance it will give with some of the existing methods of finding depreciation, besides the familiar straight-line and sinking-fund schemes.

The work starts out with a description of the use of capital in industrial plants and of the sacrifice of investment by wear and obsolescence. The general discussion is visualized by application to a hydro-electric plant. Then follows a description of the "plant ledger"—a double-entry account-book showing additions to physical plant, retirals and wastage from depreciation. After this is a further accounting phase of the general subject—a discussion of "funds" and "reserves," the distinction between which too few engineers seem to carry. A short chapter treats "depreciation and efficiency" relations, but meaning "effectiveness" rather than the engineer's "efficiency." This ends Part I, on theory.

The rest of the book is called "Part II—Practical Applications," though to the engineer it is all theory, the difference being in regard to extent of detail. This part opens up with a very good story of the growth of depreciation accounting in utility and general industrial accounting—in the one case as stimulated by commission regulation and in the other by the Federal income-tax act. Finally, there are chapters showing various schemes for computing depreciation—straight-line, reducing-balance, sinking-fund, annuity, equal-annual-payment, unit cost, inspection. The mathematical formulas going with certain of these are worked out in considerable detail.

The book has obvious merit to a high degree, and it is no detraction to state, as should be said, that the text does not go deep enough for immediate practical engineering utilization. Perhaps that is inherently impossible, but only a few steps more would have accomplished it. For examples of shortcomings: There is not a satisfactory discussion for the engineer of the ultimate nature of the elements of depreciation—wear- or weather-deterioration, service-antiquation, efficiency- or output-obsolescence, etc. Yet these are matters which at times become very important in the scrutiny of depreciation, value and rates. Further, there is no development of nomenclature to differentiate between depreciation, the wasting of assets; "depreciation," the wastage indemnity; and the several other special meanings that have become hitched to the term to make confusion confounded. The educated searcher can find an indication that the author realizes the difference between sinking-fund handling of depreciation compensation and the idea of immediate direct repayment of lost assets; but the

uninstructed engineer will not be properly illuminated on this matter, which is assuming greater importance all the while.

One of the most interesting parts of the work lies in the presentation of the "unit-cost" plan of computing depreciation. This scheme attempts to take into account the effect of decreased efficiency and output in such a way that the unit cost of product is the same for the old as for the new machine. This scheme, however, neglects the factor of interest and thereby under-rates the value of the old machine. The author would have made a useful contribution had he extended (as since has been done) the equal-annual-payment plan to cover this most general case.

## Urgent Irrigation Problems

IRRIGATION IN THE UNITED STATES: A Discussion of Its Legal, Economic and Financial Aspects—By Ray Palmer Teele, Irrigation Economist, Office of Public Roads and Rural Engineering, United States Department of Agriculture. New York: D. Appleton & Co. Cloth; 5x8 in.; pp. ix + 253. $1.50 net.

IRRIGATION MANAGEMENT: The Operation, Maintenance and Betterment of Works for Bringing Water to Agricultural Lands—By Frederick Haynes Newell, Professor of Civil Engineering, University of Illinois; former Director, United States Reclamation Service. New York: D. Appleton & Co. Cloth; 5x8 in.; pp. xi + 306; illustrated. $2 net.

Of the two books named above, the first reviews the history and status of irrigation in the United States and suggests possible means of putting irrigation on a sound economic basis, and the second book is primarily concerned with the management of going projects.

At least half of Mr. Teele's volume deals with irrigation investments and other financial questions. He concludes, broadly, that irrigation in the United States has thus far been an economic failure, whether under strictly private enterprise, local irrigation districts, the Carey Act or the United States Reclamation Service Act. Notwithstanding lack of returns on the heavy investments already made, a large increase of capital is needed. In short, the author says, the Federal Government, the states and districts, perhaps acting together, may have to finance the irrigation farmer for years before he can pay for land and water and put his land on a paying basis. Mr. Teele even goes so far as to suggest that the irrigator be "carried" by the equivalent of some form of general taxation for the sake of the good that will result to him, his locality, his state and the United States. Less radical measures are suggested, however, as capable of bringing some advance.

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Mr. Newell's "Irrigation Management" is the first comprehensive attempt to compass that subject as it exists today. Although based largely on the author's extensive and intensive experience as Director of the United States Reclamation Service, the volume is sufficiently comprehensive to serve as a guide to the management, of works small or large, under private, district, state or Federal ownership. Many of the historical, legal and economic phases of irrigation covered in Mr. Teele's book are considered by Mr. Newell also, but naturally from a different viewpoint. Other aspects of Mr. Newell's many-sided subject are physical conditions, the human element, methods of applying water and of operation generally, schedules and records, finances, crops, cattle, markets and rural credit.

The author makes clear that on the projects the irrigation manager has as large and varied a task as the manager of good-sized lighting or railway properties. The importance of the engineer and engineering services are recognized without being idolized. Business ability, knowledge of men, tact—in short, all that goes to make up the capable administrator—are given due weight.

The volume cannot fail to make its impress on the future of irrigation management in America—and for that matter on good management generally. It is fortunate indeed that Mr. Newell gave the public the benefit of his wide experience while it was fresh in his mind just after leaving the Reclamation Service.

## Railroad Valuation and Rates

RAILROAD VALUATION AND RATES—By Mark Wymond. Chicago (Rand-McNally Building): Wymond & Clark. Cloth; 5x8 in.; pp. 339; illustrated. $1.50.

Mr. Wymond has combined in this volume virtually three books on railroad subjects none too intimately related—except that the persons interested in railway valuation are pretty generally concerned in railway rates. The volume well demonstrates the gulf between valuation and rates in railroad practice, cost of service entering into rates only in a minor way compared with the use of this principle in other utility fields.

The author evidently is largely in sympathy with railroad men in his views of finance, valuation and rate making. Therefore, this book may be taken as a statement of the railway position in these matters. Indeed it has been unofficially reported that the book is indorsed by the Railway Presidents Conference—the organization that is representing the railroads of the country in matters relating to the Interstate Commerce Commission's valuation program.

While the book exhibits some of the idiosynerasies that railroad men as a group possess in regard to matters of valuation and rates compared with other utility men, the volume will be welcomed for its candid and quiet statements. Evidently the author has endeavored to preserve a judicial and thoughtful presentation of his subject. The general discussions are enriched and exemplified by data apparently derived from the author's many years of experience in railroad circles.

He starts off with the history of steam railroading in this country and describes the early rates and financing. The next section is devoted to "Promotion." In this appear such topics as the cost of delays before a railroad begins to pay, the cost of the early work, real estate, options, franchises, damages, etc. A third section is on "Construction-Reconstruction," showing the cost of work on some of the earlier lines, the continual additions to first cost, the meager early earnings, and the necessity of eventual reconstruction of the roads to reduce operating expenses. Under "Capitalization" such matters are discussed as stocks, bonds, state aid, railroad combinations, inter-company securities, holding companies, bond readjustments, reorganizations, commissions and discounts, etc.

After these matters are dismissed, valuation proper is taken up, first by discussing the purpose of valuations in general and of the Interstate Commerce Commission's valuation in particular. Various suggestions are offered as to what the Interstate Commerce Commission should consider in such matters as original cost, cost of reproduction, overhead charges, engineering, contingencies, interest during construction, reproduction less depreciation, appreci-

ation, depreciation, obsolescence, inadequacy, unit prices, land values, excess cost of acquiring land, intangible values, good-will, early deficit, development cost, etc.

Under "Rates" the author presents a "cost-of-service" principle but apparently means thereby only that the total revenues should more than meet the total expenses. Some actual figures are introduced to show American cost experience. The effect of traffic and topography on rates is described in connection with cost of service. Terminal expense is discussed and the apportionment of various expenses between the several classes of traffic.

When it comes to the actual detail scrutiny of rates to be found on American roads, the author shows the necessity of working more on the principle of value of service than cost, on account of the utter complexity of railway rate schedules and the infinite number of services inseparably intermingled. The practice of the Interstate Commerce Commission is shown typically by reference to particular districts and by the discussion of such effects as water transportation, preservation of natural advantages, competition of lines, long-and-short-haul provisions, etc.

There are some arguments that all readers may not accept. Among them are such debatable points as good-will (p. 199); it is held that even a shipper having no choice of roads has the option of going into his business or staying out of it, his decision being based on railway rates and services, so that there is an element of good-will in such traffic.

Again, on pp. 209 and 211, the author upholds the contention of railroad men that all the component parts of a railroad may and do depreciate, but that the railroad cannot suffer depreciation. On p. 266 and following, the comparisons made with rates for electric current are weakened by attempting to show that the lower cost of all-day power over short-hour current is due to the value of the service. Value of service enters some electricity rates for commercial establishments, where competition with steam power has to be met, but in the majority of cases the cost of 24-hr. service is so much lower than the short-hour service that cost may be said to determine the rate. Again, on p. 269, in discussing value of service by the analogy of taxation, the author states that the owner of a $20,000 building on a 50-ft. front gets no more service for his taxes than the owner of a $3,000 building on the same frontage—obviously neglecting such fundamental functions of tax-supported government as police and fire protection which are properly measured by the value of the investment protected.

In making the unqualified statement (p. 260) that cost of service is a limiting factor in all rates below which no rate can go if it does not cover the actual out-of-pocket expense, the author seems to neglect branch lines that are operated at an appreciable loss in order that the profits may be secured on the main line. These last few paragraphs disclose the comparative triviality of the criticisms that can be made—except as to the treatment of depreciation already noted.

## Some Elevator History

ELEVATORS: A Practical Treatise on the Development and Design of Hand, Belt, Steam, Hydraulic and Electric Elevators—By John H. Jallings, Mechanical Engineer and Elevator Expert with Karstner & Hecht Co., Chicago. Chicago: American Technical Society. Cloth; 6x9 in.; pp. 217; 172 illustrations. $1.50.

In writing this book the author has taken pains to present in considerable detail the history of American elevators and he shows some interesting types—like the steam lifts—now practically unused. The first part of the book confines itself to hand elevators. Then come belt-power machines and a chapter on worm gearing, which has been important in the development of power lifts. A few pages are given up to steam types and the several hydraulic elevators. A final section presents the subject of electric hoisting and control equipment.

## Steel-Framed Mill Buildings

REVIEWED BY CLYDE T. MORRIS*

THE PRACTICAL DESIGN OF STEEL-FRAMED SHEDS—By Albert S. Spencer. New York: D. Van Nostrand Co. Cloth; 6x10 in.; pp. xv + 163; 13 folding plates. $3.50 net.

The preface states:

> The object of this book is that of providing for the student and the designer a guide to the practical design of shed framework and foundations. . . . The author has presumed of the reader an intimate knowledge of the theory of structures and of practical designing.

The theoretical treatment, as indicated in the preface, is very limited. There is a short discussion of wind pressures to be used in designing and of the various assumptions made as to the degree of fixity existing at the tops and bases of the "side stanchions," or columns, as they are known in America.

Four types of "sheds" (mill buildings) are considered, divided according to the degree of fixity of the ends of the columns and the presence or absence of "side stays" (knee braces). Standard tables of stresses and sizes are given for various spans and heights for three of these types, both for roofs covered with corrugated sheets and for slate roofs. The pitch of the sheeted roofs is 24½° and of the slate roofs 30°. All of the trusses are of the Fink or the modified Fink type. At the end of the book a number of plates are given showing typical stress diagrams and standard methods of framing.

Chapter VII, on "External Coverings," and Chapter VIII, on "Gutters, Pipes, Ventilation, Doors, Windows and Skylights," give standard British practice in these matters.

The book might be of value as a handbook in the drafting rooms of structural companies in England, but will probably find a very limited use in this country, as the standards used do not fit American practice.

## A Book on Scaffolding

SAFETY ENGINEERING APPLIED TO SCAFFOLDS—The Travelers Insurance Co., Hartford, Conn. Cloth; 6x9 in.; pp. vi + 354; 127 illustrations. $3.

The first chapter of this book on a rarely discussed subject seeks to establish the reality of the scaffold hazard. Those who follow building construction will need only to read this chapter heading and turn to the next. Here scaffolds are considered generally—pole, outrigger, ladder, suspended, chimney stagings, and even falsework. Following this are a number of sections dealing exhaustively with the characteristics, special hazards and the good features of various designs of scaffolding.

The masons' horse is widely used in the construction of buildings, both on the inside and the outside of the wall, and it is a prolific source of accident. A scaffold consisting of horses and planks is a loose device that when built for high work is none too stable. Section 9

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treats of this arrangement, giving a sketch of a well-designed horse. When horses are set tier upon tier it is advisable to brace the temporary structure. When this type of scaffolding reaches 6 or 8 tiers—a dangerous and ill-advised practice, by the way—it is recommended that every horse be nailed to the planks it supports and to those upon which it rests.

"Structures Similar to Scaffolds" is the title of Section 12. It touches upon such subjects as sidewalk protection, material hoists, arch centers and other falsework.

The section following carries the sober heading General Counsel, and men in the building trades who are responsible for the safety of others would do well to at least endeavor to assimilate some of the wise advice offered here. Unquestionably every building superintendent should possess a copy of this eminently practical book, and in not a few cases it would be a downright economy for his company to purchase it and present it to him.

## Valuation for Rate-Making

REVIEWED BY LEONARD METCALF*

VALUE FOR RATE-MAKING—By Henry Floy, Fel. Am. Inst. E. E., M. Am. Soc. C. E., Consulting Engineer. New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. viii + 322; illustrated. $4 net.

Only those familiar with the subject can have a just appreciation of the tremendous amount of labor which has entered into the writing of this book. It is clearly a composite work embodying, as the author frankly states in his preface, much matter originally prepared by him in discussing technical papers upon "Valuation" and "Rating" and in assisting in the writing of legal briefs in public-utility cases covering a wide field. It is the work of an alert and studious mind which has had the benefit of broad practical experience and contact with some of the ablest lawyers and jurists in this country. The arrangement of the matter is logical, the discussion lucid, and the legal citations are apt and up to date.

The author opens with an introduction covering a discussion of the basis for rates, right or regulation, development of law and a quotation of the Federal Valuation Act. Chapter II is given over to definitions.

In Chapter III the fundamentals of valuation are admirably presented, particular attention being called to the unfairness and illegality of attempting to apply *ex post facto* rulings to utility regulation; and to the general tendency to ignore the fact that newly organized utilities originated under present-day regulation cannot be treated the same as long-established utilities which have been created and operated without much restriction as to their profits and rate of return. The author recognizes the trend of public service commission rulings toward investment cost as a fair measure of value and control, giving an assured return commensurate with the nature of the guarantee, though "such basis is not sanctioned by the United States Courts," which have in a long line of decisions adhered to present value and a variable rate of return commensurate with the risks of the business. The discussion of the difference between the competitive and noncompetitive utility is well presented, and the popular agency theory is thoroughly exploded. The necessity for establishing rates for periods rather than annually, on account of the impracticability of repeatedly raising and lowering the rates to closely follow the value of or the investment in the property, is recognized by the author.

Chapter IV, upon "Fair Value for Rate Making," covers the general principles involved, discussion upon the distinction between investment cost and present value, fair rate and an excellent presentation of the necessity for recognizing and encouraging in some practical way efficiency in operation—perhaps the most difficult problem facing regulating bodies. The valuation of the service is briefly touched upon, but no specific suggestions are made as to methods for its determination. A striking example of the failure of the regulating body to recognize the value of this most important element, as well as the cost and effect of good organization, business acumen and efficiency in rendering service, is cited in the familiar Wells-Fargo decision of the California Railroad Commission.

In Chapter V the details of the cost of reproduction are intelligently discussed, though the subject of used and unused property or property to be included in the rating base, was overlooked.

Chapter VI covers Land, Paving and Water Rights. The discussion as to the latter is particularly timely. Though brief, it is significant. The author recognizes the growing importance of the doctrine of beneficial use and that history, in the proper treatment of water rights, is in the making. The present situation of the doctrine of State vs. Federal ownership and control of waters within its own bounds, now pending before the United States Supreme Court, is well outlined.

Chapter VII follows with a good discussion upon Franchises, Working Capital and Bond Discounts.

Chapter VIII, upon "Going Value," is perhaps the best summing up of the subject which has yet appeared. The author's analysis of Justice Day's (United States Supreme Court) dicta upon "Going Value" in the Des Moines Gas Co. case is as convincing as it is fearless but courteous, and his analysis of the historic attempt of the New York Public Service Commission, First District, to practically exclude going value from the rating base is clear, cogent and significant.

Chapter IX is devoted to the subject of "Depreciation" and contains a forceful argument for a consideration of the property as an operating entity and not as an aggregation of detached and perishable structures. The essential difference between the problem of dealing with the property having structures, for the most part of very long life, as the gravity water-works, and those of comparatively short life, as the railroad, might have been somewhat more clearly drawn, and the reader's mind might have been better prepared for the subject had his attention been called at the outset to the basic difference in principle involved in the two theories of depreciation accounting—the first, on the "service basis," in which depreciation is in general not taken care of until it has actually accrued; the second, the "condition theory," in which the ultimate effect of depreciation is anticipated, consideration being given not only to the effect of wear and tear, but to the often greater effect of mere lapse of time, with resulting shortening of useful-life period of the property.

The book is a most important and timely contribution to the subject of "Valuation for Rate-Making" and will

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be found of marked service to engineers and lawyers, and others having to do with such problems.

The untimely death of the author, recently noted in *Engineering News*, is a distinct loss to the profession.

## Occurrence and Use of Coal

COAL: ITS ECONOMICAL AND SMOKELESS COMBUSTION—By James F. Cosgrove. Philadelphia, Penn. (357 West Duval St., Germantown): Technical-Book Publishing Co. Cloth; 6x9 in.; pp. 273; 33 illustrations. $3.

Mr. Cosgrove has prepared a descriptive discussion of the geology and chemistry of coal, and of the physics and engineering of fuel combustion, in a plain and readable fashion that ought to make the fundamental information readily available for businessmen, factory managers, civil engineers, contractors, and all others not specially trained in power generation processes. How comparatively small a volume is really essential to treat adequately many important engineering topics is thus again exemplified.

The author first discusses the classification of coal according to its carbon and hydrogen contents. Then he gives a classification with descriptive comment according to the more familiar grouping as bituminous, anthracite, semianthracite, semibituminous, coking, and noncoking, lignite, peat, etc. After this there is a further classification of coals for their use—domestic service, stationary heating and power plants, locomotive boilers, steamship service, smithing, coke making, gas making, cement burning and metallurgical processes. After this is a chapter on composition, and then one on the effects of size, weathering, spontaneous combustion, etc.

The clinkering of coal ash in its relations to the coal to be selected for various services forms one of the important sections of the book. After this, and before the further discussion of combustion, etc., is taken up, there is a section of some fifty pages on the geology of American coal fields. Noteworthy among the discussions in the remaining part of the book are those on the purchase of coal taking into account heat value and impurities, and on prevention of smoke; a useful appendix gives the analyses of 319 American coals from scattered localities.

## Theory of Cost of Service for Railway Rates

RAILWAY MONOPOLY AND RATE REGULATION—By Robert James McFall, Sometime Fellow in Economics in Columbia University and Instructor in Economics in the University of Minnesota. ["Studies in History, Economics and Public Law," edited by the Faculty of Political Science of Columbia University. Whole No. 164.] New York: Columbia University; Longmans, Green & Co. Paper; 6x10 in.; pp. 223.

Professor McFall has given here a careful exposition of the economic basis for the present-day principle of service cost applied to adjustment of railway rates. His fundamental thesis is not, as many would suppose, that detailed tariffs should follow closely the costs of particular service, but that the rate system as a whole must be equal to the cost of service—including therein the "fair return on fair value." He would adjust particular tariffs more or less in accordance with the ability of a given traffic to develop under certain rates, the starting point being the aggregate of closely assignable items.

In the course of his argument the author shows that railway monopoly—the combination of control and finance—is a social advantage compared with unrestricted competition. The evils pointed out are unnecessary maintenance of price and restriction of service. It is urged that railroad regulation be aimed at securing the maximum service rather than letting companies secure maximum possible profit, and at keeping rates down as far as the desired service permits. Such an end the author believes is as much as could be looked for with either government ownership or unrestricted competition.

## Principles of Cost Accounting

REVIEWED BY R. R. POTTER*

PRINCIPLES AND PRACTICE OF COST ACCOUNTING, For Accountants, Manufacturers, Mechanical Engineers, Teachers and Students—By Frederick H. Baugh. Baltimore (P. O. Box 682), Md.: The Author. Cloth; 6x9 in.; pp. xi + 194. $3.

While the title page of this book describes it as being for accountants, engineers, teachers and students, it appears to be written quite decidedly from the standpoint of the accountant. Engineers will find it rather a dry volume, unless indeed they should find themselves in a situation where some definite knowledge of cost accounting was required. In such a case, since the book is very compact, it should prove useful to engineers as a reference work.

The author describes a system of cost accounting which, he states, calls for little if any addition to the books which a corporation should ordinarily possess. He shows a dozen or so forms for the analysis of costs, indicating the way in which the information can be usefully summarized. These forms are given chiefly in the last two chapters, which illustrate briefly the system explained by the author in its application to departmental cost keeping and process cost keeping respectively.

Forms such as would be used for payroll analysis, production orders, requisitions, material transfers, etc., are purposely omitted. The author states that such forms are rarely of any practical value except to the business for which they were especially planned and that when one knows what data are needed the required forms are easily prepared. This policy certainly has the desirable result of making the book exceptionally concise. The same general idea is followed in the text, where a little too great care is taken not to describe the accounting system for, or even to mention, any particular line of manufacture. This certainly does not make the book any more interesting reading; and while it may for some reasons be an excellent plan, it introduces an element of vagueness and necessitates more than ordinary effort at concentration on the part of the reader.

## Hill's Public Health Revised

THE NEW PUBLIC HEALTH—By Hibbert Winslow Hill, Director, Institute of Public Health, and Medical Officer of Health of London, Canada; Professor of Public Health, Western University. New York: The Macmillan Co. Cloth; 5x8 in.; pp. 206. $1.25.

Dr. Hill has revised and extended the valuable series of syndicated articles that he wrote some five years ago and that were subsequently published in book form. (Noticed in *Engineering News*, Mar. 19, 1914.) The new publishers have greatly improved the typography and general makeup of the book.

It seems hardly necessary to state in these columns that the new public health deals primarily with the infected and infective person and the earliest possible con-

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trol of discharges from him and leaves garbarge, ashes, plumbing and the like to others, all of which is clearly and forcibly explained by the author. The book contains many practical suggestions for health-protective work.

## Electric Pole and Tower Lines

POLE AND TOWER LINES, for Electric Power Transmission—By R. D. Coombs, M. Am. Soc. C. E. New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. viii + 272; 162 illustrations. $2.50 net.

Mr. Coombs is known as an earnest advocate of departmentizing the work of a power company's engineering staff to the extent that the electrical engineers should not design the transmission lines as structures, and he cannot be charged with trying to educate electrical men into that field of applied mechanics. But nevertheless his book will be particularly useful to the many electrical engineers who cannot have civil-engineering associates to work out these problems for them. Moreover, with the good fundamental education which every successful electrical man must have had, there is no reason why a close approach to safe and economical transmission lines should not be promoted. But it will be necessary for such a man to have other books on structural design, for the author does not give an exposition of the general theory and practice of that subject.

The book opens up with introductory notes, drawn from experience, on economic grade of construction, life of materials, necessary clearances, factors of safety, fields for various types of supports, etc. The details of design begin with a discussion of loading. The author would neglect accidental loads—like falling objects—and he would advocate a single ice and wind load as applicable generally the country over, modified up or down, no doubt, as judgment dictates for a few localities. A reasonable sleet load is taken as ½ in. of ice all around a wire; the suggested wind load is 13 lb. per sq.ft. of projected area for flat surfaces and 8 lb. for the projected area of wire and ice coat.

In designing the wire and cable spans the parabolic formula is substituted for the true catenary, it being argued that the computed results are closer to actual than the actual stringing is to the designed. At this point in the book, tables and curves of wire and span data are inserted.

There are very interesting and suggestive chapters on the design of wood-pole, steel-pole, steel-tower and reinforced-concrete-pole lines. There is not presented in these sections, as already intimated, a complete procedure for design, but rather a chain of discourses on departures from ordinary structural designing—covering such topics as maximum stress and weakest sections in wood poles, flat and angle lacing for poles and towers, connections, wide-base structures, flexible frames, etc. A notable addition is the tabulated data on about fifty wood- and ninety steel-supported lines.

Summed up, the author's recommendation seems to be to use combined ice and wind loads with very moderate broken-wire conditions, to avoid excessive l/r values and thin sections, and to use rather low factors of safety. In fact, he specifically argues against high factors of safety designed to protect against the ignorance of the designer.

There is a good chapter on foundations, although it might have been appreciably enriched by reprinting constructions shown a year ago in an extended topical discussion before the American Institute of Electrical Engineers. Toward the end of the book are assembled a miscellaneous selection of practical matters all of great importance and well presented—protective coatings, tie wires, proper insulator and pin types, arm braces, guys, anchors, erection practices and costs, accident prevention, etc. A valuable feature is the large number of specifications inserted at various parts of the text.

## Electric Railway Practice

ELECTRIC RAILWAY ENGINEERING—By C. Francis Harding, Fel. Am. Inst. E. E., Professor of Electrical Engineering, Director of Electrical Laboratories, and Dressel D. Ewing, M. Am. Inst. E. E., Assistant Professor of Electrical Engineering, Purdue University. Second edition fully revised, enlarged and reset. New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xv + 416; 190 illustrations. $3 net.

The appearance of the second edition of Professor Harding's work on electric-railway engineering for advanced students reminds teachers of the discussions on the appearance of the first edition as to whether the strictly theoretical and somewhat academic procedures should be exclusively presented to budding minds, or whether it might not be assumed that the students had been earlier acquainted with such procedures and could be introduced to various practical short cuts that were in common use, especially in preliminary work. The author employed the second plan.

Comparison of the first and second editions shows the addition of one new chapter—on locomotive train haulage—and the general insertion all through of such new matter as brings the text up to date. The book is of service not only to teachers and students, but to utility executives and casual readers who desire to inform themselves on the engineering steps in establishing an electric railway in operating shape.

## NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor, the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

ADVISORY PAMPHLET ON CAMP SANITATION AND HOUSING—By J. J. Rosenthal. San Francisco, Calif. (525 Market St.): Commission of Immigration and Housing of California. Fourth revised edition. Paper; 6x9 in.; pp. 56; illustrated.

ANNUAL REPORT ON THE MINERAL PRODUCTION OF CANADA, 1914—Ottawa, Ont.: Mines Branch, Department of Mines of Canada. Paper; 7x10 in.; pp. 362.

BRIDGE ENGINEERING—By J. A. L. Waddell, M. Am. Soc. C. E., Senior Partner of Waddell & Son, Consulting Engineers, Kansas City, Mo. In Two Volumes. New York: John Wiley & Sons. Cloth; 6x9 in.; pp. lxxv + 2,177; profusely illustrated. $10.

COAL MINERS' POCKETBOOK: Formerly the "Coal and Metal Miners' Pocketbook"—Principles, Rules, Formulas and Tables. Eleventh edition, revised, enlarged and entirely reset. New York: McGraw-Hill Book Co. Flexible leather; 4x7 in.; pp. xxv + 1,172; illustrated. $4 net.

COMMISSION ON BUILDING DISTRICTS AND RESTRICTIONS (OF NEW YORK CITY): Final Report, June 2, 1916—New York (Municipal Building): Committee on the City Plan, Board of Estimate and Apportionment. Paper; 7x10 in.; pp. 100; illustrated.

Acting under a 1914 amendment to the charter of New York City, the Board of Estimate appointed the Commission named above, which had been preceded by a Heights of Buildings Commission. After two years' work the new Commission submitted a tentative report, accompanied by a series of maps. These maps showed numerous geographical divisions of the city divided into "use" districts, the latter including residence, business, unrestricted and undetermined sections for each division. After public hearings on the tentative scheme, the

present report was formulated. It includes a resolution, with explanatory diagrams, establishing "use districts" and regulating the height of buildings.

A COMPREHENSIVE PLAN OF INSURANCE AND ANNUITIES FOR COLLEGE TEACHERS—By Henry S. Pritchett, President of the Carnegie Foundation. New York (576 Fifth Ave.): The Carnegie Foundation for the Advancement of Science. Bulletin No. 9. Paper; 7x10 in.; pp. 67.

COMPREHENSIVE PLAN OF NEWARK—Newark, N. J.: Office of the City Plan Commission; Harland Bartholomew, Secretary. Paper; 6x9 in.; pp. 180; illustrated.

One of the best-considered and most business-like city-plan reports so far published. It is the result of more than three years' study, under the immediate direction of Harland Bartholomew, Engineer and Secretary to the Commission, with George B. Ford and E. P. Goodrich as expert advisers. The four main topics are: Streets and Transportation; Recreation and Civic Beauty; Housing and Public Control of Private Development; Planning the Greater City and a Program for Future Work.

CONNECTICUT STATE PUBLIC UTILITIES COMMISSION: Fourth Annual Report, including the Financial Reports of All Public Service Companies for the Year Ending June 30, 1915, with Statistical Tables Relating Thereto. Hartford, Conn.: Henry F. Billings, Secretary. Cloth; 6x9 in.; pp. 688.

COPPER SULPHATE TREATMENT OF ST. PAUL, MINNESOTA, WATER-SUPPLY—By Prof. N. L. Huff, Department of Botany, University of Minnesota, with Introduction by Garrett O. House, General Superintendent, Bureau of Water, St. Paul, Minn. [Reprinted from the "Journal" of the American Water-Works Association, Vol. 3, No. 2, June, 1916.] Paper; 6x9 in ; pp. 581-621; illustrated.

DEPARTMENT OF PUBLIC WORKS, NEW SOUTH WALES: Report for the Year Ended June 30, 1915—Sydney, N. S. W., Australia. Paper; 8x13 in.; pp. 145; illustrated. 7/6.

DISCUSSION OF POWER ESTIMATES FROM STREAM FLOW AND RAINFALL DATA—By Clemens Herschel. [Reprinted from the "Journal" of the Boston Society of Civil Engineers, Vol. 3, No. 6, June, 1916.] Paper; 6x9 in.; pp. 303-313; illustrated.

FOREIGN COMMERCE AND NAVIGATION OF THE UNITED STATES: Report for Year Ending June 30, 1915—Washington, D. C.: Bureau of Foreign and Domestic Commerce. Cloth; 9x12 in.; pp. 928. $1 a copy; from Superintendent of Documents, Washington, D. C.

GEOLOGIC ATLAS, UNITED STATES GEOLOGICAL SURVEY—Washington, D. C. Paper; 18x20 in.; illustrated.

Folio No. 199, Silver City, N. M.—By Sidney Paige. Pp. 19. Folio No. 201, Minneapolis-St. Paul, Minn.—By Frederick W. Sardeson. Pp. 14.

INDUSTRIAL ACCIDENT PREVENTION—Albany, N. Y.: New York State Department of Labor, Bureau of Statistics and Information. Special Bulletin No. 77. Paper; 6x9 in.; pp. 54; illustrated.

INDUSTRIAL PREPAREDNESS—By C. E. Knoeppel, Author of "Maximum Production in Shop and Foundry" and "Installing Efficiency Methods." New York: The Engineering Magazine Co. [Industrial Management Library.] Cloth; 5x8 in.; pp. viii + 145. $1.

THE INFLAMMABILITY OF ILLINOIS COAL DUSTS—By J. K. Clement and L. A. Scholl, Jr. Washington, D. C.: United States Bureau of Mines. Bulletin 102. Paper; 6x9 in.; pp. 74; illustrated.

INTERIM REPORT: STATISTICAL EXAMINATION OF CERTAIN GENERAL CONDITIONS OF TRANSPORTATION BEARING ON THE ECONOMIC PROBLEM OF THE PROPOSED GEORGIAN BAY CANAL—By W. Sanford Evans, Chairman, Georgian Bay Canal Commission, Ottawa, Canada. Paper; 7x10 in.; pp. 150; illustrated.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION: Proceedings of Convention Held at Philadelphia, Aug. 17-19, 1915. Lima, Ohio: A. L. Woodworth, Secretary and Treasurer. Cloth; 6x9 in.; pp. 226; illustrated.

MANUAL OF AMERICAN STEEL AND WIRE COMPANY'S PROCESS OF WATER PURIFICATION WITH SULPHATE OF IRON—208 South La Salle St., Chicago, Ill. Paper; 6x9 in.; pp. 152; illustrated.

Although designed primarily to promote the use of sulphate of iron in water treatment, this pamphlet contains a considerable amount of information on water treatment in general, many pages of tables and numerous illustrations of filtration plants.

MASSACHUSETTS STATE BOARD OF HEALTH: Annual Report for the Fiscal Year Ended Nov. 30, 1914—Boston, Mass. Cloth; 6x9 in.; pp. 781.

MECHANICAL ENGINEERS' HANDBOOK: Based on the Huette and Prepared by a Staff of Specialists—Lionel S. Marks, Editor-in-Chief, Professor of Mechanical Engineering, Harvard University and Massachusetts Institute of Technology. New York: McGraw-Hill Book Co. Flexible leather; 4x7 in.; pp. xxiii + 1,779; illustrated. $5 net.

THE METALLURGY OF STEEL—By F. W. Harbord, Assoc. R. S. M., F. I. C., formerly Consulting Metallurgical and Analytical Chemist to the Indian Government, Royal Indian Engineering College, Coopers Hill; and J. W. Hall, Assoc. M. Inst. C. E., Consulting Engineer, Birmingham. (In two parts.) Vol. I, Metallurgy. By F. W. Harbord. Vol. II, Mechanical Treatment. By J. W. Hall. Fifth edition, enlarged and revised. Philadelphia: J. B. Lippincott Co. [Griffin's Metallurgical Series.] Cloth; 6x9 in.; pp. xvi + 522 and xviii + 411; 54 folding plates, comprising 115 figures, over 500 illustrations in text and nearly 80 photomicrographs of steel sections. $12.50.

OHIO STATE BOARD OF HEALTH: Annual Report for the Year Ending Dec. 31, 1914. Columbus, Ohio: E. F. McCampbell, M. D., Secretary and Executive Officer. Paper; 6x9 in.; pp. 894

THE PLANNING OF THE MODERN CITY: A Review of the Principles Governing City Planning—By Nelson P. Lewis, M. Am. Soc. C. E., Chief Engineer of the Board of Estimate and Apportionment of New York City. New York: John Wiley & Sons. Cloth; 6x9 in.; pp. xv + 423; 62 text illustrations and 87 plates. $3.50 net.

THE POLLUTION OF NEW YORK HARBOR AND ITS REMEDY—By Kenneth Allen, Engineer of Sewage Disposal, Board of Estimate and Apportionment of New York City. [Reprinted from Proceedings of the Connecticut Society of Civil Engineers for 1916.] Paper; 6x9 in.; pp. 28-48; illustrated.

POWER TRANSMISSION BY LEATHER BELTING—By Robert Thurston Kent, Jun. Am. Soc. M. E., Consulting Engineer. New York: John Wiley & Sons. [Wiley Engineering Series.] Cloth; 5x8 in.; pp. vi + 114; 31 illustrations. $1.25 net.

PRACTICAL COST KEEPING FOR CONTRACTORS: A Book Giving a System of Accurate Cost Keeping and the Methods Used for Adapting It to All Classes of Construction Work—By Frank R. Walker, Author of "The Building Estimator's Reference Book." Chicago (30 North Michigan Ave.): The Author. Cloth; 4x7 in.; pp. 273; 159 illustrations. $2.

THE PREDETERMINATION OF TRUE COSTS AND RELATIVELY TRUE SELLING PRICES—By Frederic A. Parkhurst, M. E., Organizing Engineer. New York: John Wiley & Sons. Cloth; 6x9 in.; pp. viii + 96; 30 illustrations. $1.25 net.

PRINCIPLES OF ELECTRICAL DESIGN: D. C. and A. C. Generators—By Alfred Still, Fel. Am. Inst. E. E., Professor of Electrical Design, Purdue University. New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xiv + 365; 146 illustrations. $3 net.

PROCEEDINGS OF THE FIRST INTERNATIONAL ROAD CONGRESS Held Under the Auspices of the Worcester Chamber of Commerce, Dec. 14-17, 1915. Worcester, Mass.: William J. Conlon, General Secretary, Worcester Chamber of Commerce. Paper; 7x10 in.; pp. 112. 50c.

PUBLIC SERVICE COMMISSION, SECOND DISTRICT, STATE OF NEW YORK: Annual Report for Year Ended Dec. 31, 1915. Vol. I.—Albany, N. Y. Cloth; 6x9 in.; pp. 1,114.

PUBLIC UTILITIES COMMISSION OF MAINE: Annual Report for Year Ending Oct. 31, 1915. Vol. II, Relating to Topography, Geology and Water Resources—Augusta, Maine. Cloth; 6x9 in.; pp. 146; illustrated.

EL SISTEMA DE ALCANTARILLADO Y PAVIMENTACION DE LA CIUDAD DE LA HABANA—Por Luis Morales y Pedroso, Ingeniero Civil, S. S. C. I., Ingeniero Jefe del Negociado de Suministro de Agua, Cloacas e Ingenieria Municipal de la Secretaria de Obras Publicas, Designado por el Gobierno Miembro de la Comision Nombrada para Investigar el Cumplimiento del Contrato por el Cual se Ejecutaron Las Obras. [Revista de la Sociedad Cubana de Ingenieros de parte de los numeros 2, 3 y 4 del Vol. VIII.] Havana, Cuba: The Society. Paper; 7x10 in.; pp. 353; illustrated. $1.

STRENGTH AND OTHER PROPERTIES OF CONCRETES AS AFFECTED BY MATERIALS AND METHODS OF PREPARATION—By R. J. Wig, Engineer Physicist; G. M. Williams, Assistant Engineer Physicist, and E. R. Gates, Assistant Physicist. Washington, D. C.: United States Bureau of Standards. Technologic Paper No. 58. Paper; 7x10 in.; pp. 172; illustrated.

THE STRENGTH AND STIFFNESS OF STEEL UNDER BIAXIAL LOADING—By Albert J. Becker. Urbana, Ill.: University of Illinois. Engineering Experiment Station Bulletin No. 85. Paper; 6x9 in.; pp. 65; illustrated. 35c.

TESTS OF REINFORCED-CONCRETE FLAT-SLAB STRUCTURES—By Arthur N. Talbot, Professor of Municipal and Sanitary Engineering and in Charge of Theoretical and Applied Mechanics, and Willis A. Slater, Research Assistant Professor of Applied Mechanics. Urbana, Ill.: University of Illinois. Bulletin No. 84, Engineering Experiment Station. Paper; 6x9 in.; pp. 128; illustrated. 65c.

TESTS OF THREE LARGE-SIZED REINFORCED-CONCRETE SLABS UNDER CONCENTRATED LOADING—By A. T. Goldbeck, Engineer of Tests, and E. B. Smith, Associate Mechanical Engineer, Office of Public Roads and Rural Engineering. [Reprinted from Journal of Agricultural Research, Vol. VI, No. 6, Department of Agriculture, Washington, D. C., May 8, 1916.] Paper; 7x10 in.; pp. 205-234; illustrated.

THE THEORY AND PRACTICE OF MODERN FRAMED STRUCTURES Designed for the Use of Schools and for Engineers in Professional Practice—By the Late J. B. Johnson, C. E., C. W. Bryan, C. E., Chief Engineer of the American Bridge Co., and F. E. Turneaure, C. E., Dean of the College of Mechanics and Engineering, University of Wisconsin. (In three parts.) Part III, Design. Ninth edition, rewritten by F. E. Turneaure and W. S. Kinne, Associate Professor of Structural Engineering, University of Wisconsin. New York: John Wiley & Sons. Cloth; 6x9 in.; pp. xii + 486; illustrated. $4 net.

THE TREND OF MODERN WATER PURIFICATION METHODS—By C. Arthur Brown, Chief Engineer, Engineering Bureau-Water Purification, American Steel and Wire Co. [Paper for Convention of Southwestern Water-Works Association held at Waco, Tex., May 8-10, 1916.] Dallas, Tex.: The American Steel and Wire Association of Texas. Paper; 5x7 in.; pp. 41.

TRIANGULATION IN CALIFORNIA, 1913-1915—Washington, D. C.: United States Geological Survey. Bulletin 644-C. Paper; 6x9 in.; pp. 25-84.

WATER-SUPPLY PAPERS, UNITED STATES GEOLOGICAL SURVEY—Washington, D. C. Paper; 6x9 in.; illustrated.

No. 374, Ground Water in the Hartford, Stamford, Salisbury, Willimantic and Saybrook Areas, Connecticut—By Herbert E. Gregory and Arthur J. Ellis. Pp. 150. No. 383, Surface Water-Supply of the United States, 1914; Part III, Ohio River Basin. Pp. 121. No. 398, Ground Water in San Joaquin Valley, California—By W. C. Mendenhall, R. B. Dole and Herman Stabler. Pp. 310.

# Field and Office

## Snatching Wagons Out of Pits

By James F. Fouhy*

Pulling wagons to the street level, by means of a line to a snatchblock and thence to an engine usually saves horses and time. This was the method employed by the Degnon Contracting Co. and the United States Realty and Improvement Co. in excavating Routes 4 and 38 of the Seventh Ave. Subway, New York City. The view is of the operation at Charles St., and shows the timber incline up which the dump wagons were hauled. The electric hoist is shown on the side of the cut. Mucking is done by a steam shovel, working on the farther side of the temporary wooden crossing.

The snatch line is attached to the hound on the wagon and runs to a block anchored to a deadman located a few feet beyond the top of the incline. The height above ground at which the snatchblock was attached was found to be of considerable importance, especially on 15 to 20% grades. With the block two or three feet above the surface the forward end of the pole and the harness rose, making it very difficult to manage the horses. A block lying on the ground gave the best results. At first the cable was hitched to the front end of the pole, but after several poles had been pulled out and some had been broken the change was made.

This method allows the wagon to take any position transversely on the runway, a great advantage in shovel work. Another advantage not possessed by the barney method (described in *Engineering News* of Nov. 4, 1915) consists in the assistance given to a wagon on its down trip, at which time the cable is attached to the rear end. Prior to using this method an extra team—and sometimes two extras—were used to snatch wagons to the street level.

SNATCHING A WAGON OUT OF A NEW YORK SUBWAY EXCAVATION
Small insert shows that rope was attached to hound of wagon

## Keeping Progress Record of a Tunnel Repair Job

Reinforcing the Radebaugh tunnel on the Pennsylvania R.R. at Greensburg, Penn., was such an extensive performance that special effort was required to keep a full record of the progress made. At first this was not attempted, but in view of the various requests for reports received by the construction office, the desirability of a comprehensive system of daily record was apparent. The form devised for this work is illustrated herewith.

To understand the progress sheet, a brief description of the methods used to reinforce this tunnel is necessary. For some years there had been occasional falls of portions of the brick lining of the tunnel. These accidents resulted from the fact that part of the tunnel had been built on a coal vein, the result being a settlement of the structure. To correct this last September two work-

*Assistant Engineer, Public Service Commission, First District, New York.

ing headings were driven parallel to the tunnel and along side of the springline. From these headings the excavation over the arch was accomplished. The headings terminated at an old shaft 850 ft. from the portal. Concrete was blown in over the arch and finally the working drifts were filled with concrete, by the pneumatic method.

Each morning entries are made on the progress sheet covering the work of the preceding 24 hr. The figures

PROGRESS SHEET OF RADEBAUGH TUNNEL-REPAIR JOB

| Date | This Day | | | Previous Report | | | Total to Date | | | Remaining Excavation | Remaining Concreting | Concreting North Drift | | Concreting South Drift | | Concreting Over Arch | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ground Uncovered | Timbered | Concreted | Open Excavation | Timbered | Concreted | Open Excavation | Timbered | Concreted | | | This Report | Total to Date | This Report | Total to Date | This Report | Total Remaining |
| May 31 | .... | .... | .... | .... | .... | .... | 340 | 750 | 430 | 80 | 420 | .... | 320 | .... | 340 | .... | ..... |
| June 1 | 10 | 15 | 8 | 334 | 750 | 430 | 342 | 765 | 438 | 70 | 412 | 30 | 350 | 20 | 360 | .... | ..... |
| June 2 | 8 | 6 | 12 | 330 | 765 | 438 | 338 | 771 | 450 | 62 | 400 | 28 | 378 | 12 | 372 | .... | ..... |

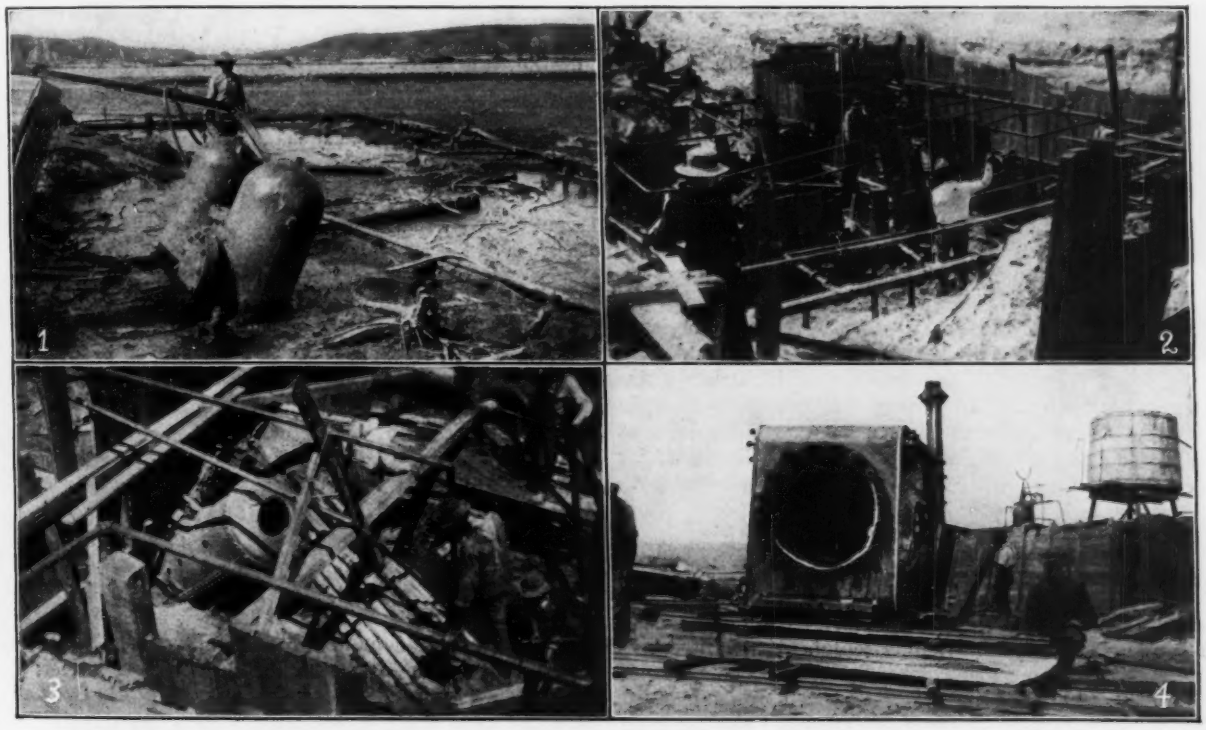
for the first three columns represent the work accomplished on the day just passed and are obtained by measurement every morning. Column 5 headed "Open Excavation" represents that part of the tunnel that has been uncovered, which part is usually timbered and ready for the concrete relining. To obtain this figure add the "Ground Uncovered This Day" (Col. 2) to the open excavation of the "Previous Report" (Col. 5), subtracting from this sum the part concreted "This Day" (Col. 4).

The column, "Timbered" to date, is obtained by adding Col. 3 to Col. 6. The figure representing that part of the tunnel concreted to date is obtained in a similar manner. The data for the remaining columns are determined in like fashion.

# Salvaging a Flooded Pumping Plant in California

By Roy A. Silent*

Southern California was visited by severe rainstorms in January, 1916. On the San Luis Rey River in San Diego County the flood damage was exceptionally severe, practically all the bridges being washed away. The pumping plant of the Oceanside Mutual Water Co. was



FIGS. 1 TO 4. VIEWS OF SALVAGING OPERATIONS AT OCEANSIDE MUTUAL WATER CO., FOLLOWING JANUARY FLOOD IN CALIFORNIA

Fig. 1—General view before salvaging began. Fig. 2—Sheeted excavations around boilers. Fig. 3—Excavation around No. 1 boiler. Fig. 4—Moving low-pressure cylinder to higher ground; weight, 6,500 lb.

200 yd. south of the river and about 3 mi. above the mouth. The soil was typical "sandy bottom" land overgrown with willows. The machinery was housed in a reinforced-concrete building 70x40 ft. in plan. The main pumping unit consisted of an Allis-Chalmers horizontal Corliss cross-compound high-duty pumping engine of 2,600,000 gal. per 24 hr. This engine obtained water from a sump and delivered it through a 16-in. force main against a total head of 215 ft. The weight of the unit, with foundation, was in excess of 335,000 lb. Water was extracted from the wells and delivered to the sump by means of an 8-in. centrifugal pump belted to a 35-hp. Ames high-speed engine weighing 5,650 lb. Steam was furnished by two 103-hp. Sterling boilers. The stack

*With J. B. Lippincott, 1134 Central Building, Los Angeles

was made of riveted steel and rose 50 ft. above the engine-room floor.

It was impossible to find firm bearing when the plant was erected, as the well logs showed that the underlying quicksand extended down 100 ft. Accordingly, the foundations were mushroomed out and were extended below the level of the groundwater, which stood about 6 ft. under the engine-room floor.

At the time of the heavy storm of Jan. 17 the plant was not damaged, but the river changed its course sufficiently to reduce the distance between the living stream and the pumphouse one-half. On the night of Jan 27, in spite of all efforts to save it, the building was completely demolished by the river, which further changed its course so that the main channel was flowing directly over the former site of the plant, leaving a cut bank 4 ft. high, 200 ft. to the south. When the river had subsided to some extent, it was diverted by an earth and brush levee to a point 150 ft. north of the building.

Salvaging work was undertaken on Mar. 1 by the Bent Construction Co., the work being directed by the engineering offices of J. B. Lippincott, both firms having their home offices in Los Angeles. (See Fig. 1 for the general condition of the plant at the time of the arrival of the salvaging equipment.) The water plane stood at the ground surface, and the quicksand was so treacherous that it was necessary to construct a roadway of crossties from the top of the bank to the plant in order to place the pumps and boiler properly. It was also necessary to construct 150 ft. of levee in order to protect the equipment, as the surface of the sand was but 2 in. above the level of the river. As further protection, an earth levee 3 ft. high was thrown up entirely around the workings.

The method of unwatering was devised by the contractor, who does not care to have the details of the operation made public. A row of sheetpiling was installed around the excavation on the exposed sides. It was made up of 2x6-in. t.-and-g. Oregon-pine planks 10 ft. long, surfaced on one side. These were sharpened and jetted their full length into the sand. Progress was much hampered by underlying brush and débris. In some places it was impossible to get the piling down at all. The cost of this work was $0.625 per lin.ft. for the driving alone, with labor at $2.25 for a 9-hr. day.

### Condition of the Flooded Machinery

The main engine was found to be practically intact and the damage purely nominal. The entire mass had sunk about 7 ft. below its former level and was tilted at an angle of 40° with the horizontal. It was necessary to lower the water plane approximately 12 ft. in order to remove the condenser and air pump, which formed the lowest elements of the main engine. The machine was dismantled piece by piece, the heaviest being the low-pressure cylinder, which weighed over 6,000 lb. The separate pieces were lifted with chain-blocks suspended from a heavy horse supported by tie cribbing. In some cases it was necessary to lift with jacks. When the various portions were raised clear of the foundations, a runway of cribbing was constructed and they were moved from the excavation on rollers. The accompanying views show this work in progress.

Moving to solid ground was accomplished by means of a sled or stoneboat. The heavier pieces were moved on rollers. These were supported by a movable track laid and taken up behind as the moving progressed. Pulling was done by a team of horses working with double blocks attached to successive snubbing posts. In this manner pieces weighing 5,000 and 6,000 lb. were moved 300 ft. up a 6% grade in 20 min.

The progress of the excavation was greatly impeded by the presence of brush and of structural steel formerly composing the roof trusses. In some instances trees 8 and 10 in. in diameter were encountered. An attempt was made to locate by jet the Ames engine and centrifugal pump; but the method was not satisfactory, as portions of the concrete building and structural steel were encountered, making recognition of the machines impossible. Accordingly, the entire area of their supposed position was excavated to a depth of 8 ft., but nothing of interest was uncovered. This area was explored with a 14-ft. jet. Hard material was encountered 22 ft. below the normal water surface; but whether this was structural steel or the machines sought could not be determined.

The former location of the boilers was excavated to a depth of 8 ft. and upon investigation with the jet showed no results at 22 ft. An area 200 ft. square was then marked off in 5-ft. squares below the former site of the boilers, and systematic soundings with the jet were made at the corner of each. One of the drums was located 55 ft. out of position and 8 ft. below the surface of the sand.

A crib was constructed of sheetpiling inclosing the boiler, which proved to be lying on its side, having toppled into the river. The violence of the flood was shown by the fact that the brickwork was entirely washed away. The cast-iron front was located 7 ft. from the main portion of the boiler, and the whole area was interlaced with the structural steel used to support the stack and upper drums. It was necessary to cut several of these steel beams in order to sink the crib. As fast as the tubes were uncovered, they were cut loose and removed, a Lagonda cutter being used. The bottom of the lowest drum of the first boiler was found to be 16 ft. below the water surface and 20 ft. below the former floor level of the plant.

On the removal of No. 1 boiler, boiler No. 2 was found lying partly beneath it. A second crib was then constructed to inclose it. In this case the boiler was on its side as before, but with the manholes down, which necessitated the cutting of the tubes from the outside. This was done with ripping chisels, the work being accomplished under extreme difficulties, as much of the cutting had to be done under sand and water. Difficulty was experienced with the water, as the brush and other small débris clogged the pumps, making it necessary to stop and clean them several times a day. At these times the water would rise at the rate of 6 to 8 ft. per hr. To excavate the No. 2 boiler, it was necessary to lower the water plane 26 ft. below the surface of the river, or 30 ft. below the former elevation of the engine-room floor.

At the bottom of the excavation trees were encountered, which showed that the scour must have extended to a depth of at least 35 ft. below the former surface of the ground; which fact partly explains the failure of many of the bridges and other structures supported on piling in southern California. A penetration of 35 ft

has hitherto been considered adequate in many cases.

As fast as the various pieces of machinery were removed, they were taken in hand immediately and cleaned, first with scrubbing brushes and water under pressure and then with distillate, emery cloth and rotten stone. It was found that an exposure to the air of even a half-hour allowed rust and corrosion to set in to such an extent that heroic measures were necessary to prevent serious damage. All of the boiler parts and much of the cast iron were painted, as soon as cleaned and dried, with linseed oil and graphite. The bright parts were thickly coated with heavy grease.

The salvaged machinery has been removed to a new location, where it is proposed to reërect the plant as soon as conditions warrant it. The salvaging operation was an economic success, the cost of the salvaging being approximately 25% of the value of the salvaged materials.

## Very Large Metal Flumes

The views shown herewith illustrate what is probably one of the largest metal flumes yet constructed. The diameter of each flume is 13 ft. 6½ in., and the two together carry the main canal of the Grand Valley Project of the United States Reclamation Service. Three twin flumes of this size are used on this project. The details are shown by Fig. 1.

The trestle is constructed of separate bents and stringers for each flume. The posts are 10x12 in. and the stringers 10x14 in., 32 ft. long, trussed in the center as shown. The entrance to the two flumes is a specially

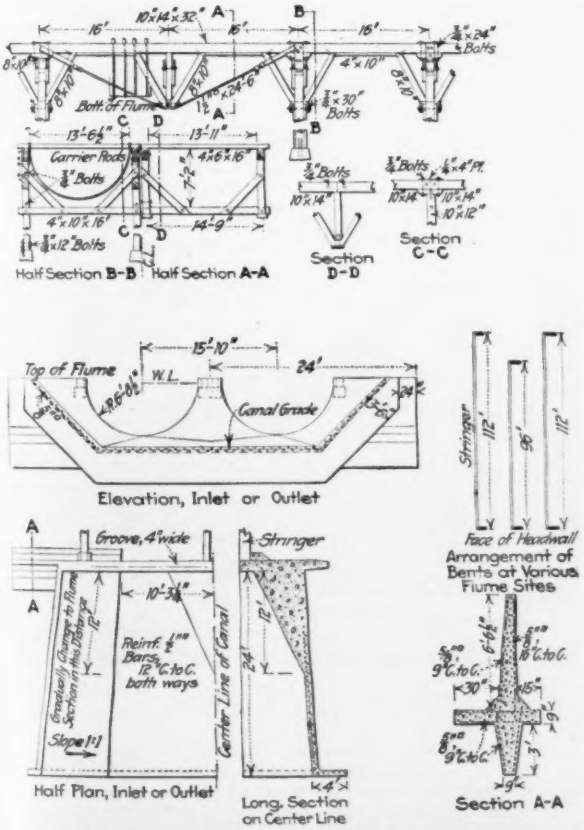



FIG. 1. DETAILS OF 12 FT. 6½ IN. TWIN HESS FLUMES; GRAND VALLEY RECLAMATION PROJECT

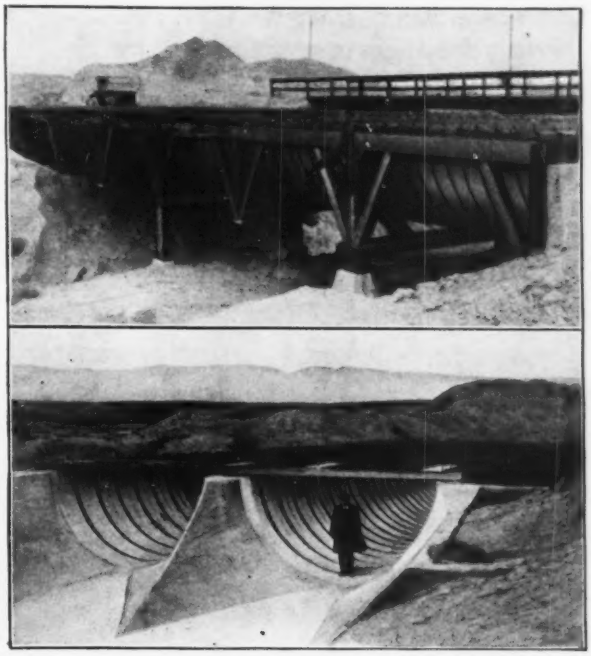


FIG. 2. FLUMES 13 FT. 6½ IN. IN DIAMETER; MAIN CANAL, GRAND VALLEY PROJECT

designed concrete structure for reducing the loss of head to a minimum. The three flumes are 144, 160 and 144 ft. (single) in length, and cost $7,507, $8,809 and $11,883 respectively, including excavation, approaches, trestle, concrete, paving, etc. J. H. Miner is Project Manager. The flumes are of the Hess type, made by the R. Hardesty Manufacturing Co., Denver, Colo.

## Illinois Road Specifications

Specifications for highway construction just issued by the Illinois State Highway Department are based upon the opinions and experience of engineers outside of the department as well as upon those of the state engineers. Drafts of the specifications as originally prepared by the engineers in the department were submitted to a number of engineers, contractors and material supply men, who were requested to examine them critically. The specifications were then revised and improved in accordance with many of the criticisms and suggestions offered.

The specifications include the following types of construction: Monolithic brick road; brick with sand-cement bed; concrete road; bituminous concrete; bituminous macadam; waterbound macadam; gravel roads and earth roads. There are also included specifications for the oiling of earth roads and the oils to be used for such work. The specifications were prepared and revised under the direction of William W. Marr, Chief State Highway Engineer.

**Durax Granite-Block Pavement** is being laid on the southerly half of the Brooklyn-Brighton viaduct at Cleveland, Ohio. The blocks are 4-in. cubes laid in sand-cement 1 : 3. As much as is laid during the day is flooded in the evening. The next day that which has been flooded the night before is grouted 1 : 1. The contract price is $2.50 per sq.yd., which includes all labor and material. The blocks cost $6.50 a ton at the quarries of the Harris Granite Quarries at Salisbury, N. C. Freight brings the cost f.o.b. Cleveland to $9.40 per ton, which will lay not less than 6½ sq.yd.

## Furniture Layout Increases Designing Efficiency

Efficiency in designing may be appreciably promoted by the furniture and layout of the drafting room, according to the experience of W. W. Horner, Engineer in charge of design of sewers and pavements, St. Louis, Mo. The accompanying view, Fig. 1, shows how the designers' and draftsmen's tables are arranged parallel and opposite the desks where the computers and estimate makers work. The aim is to coöperate with the least possible lost motion and confusion. Fig. 2 shows one of the computer's desks, which have served their purpose admirably. It is a standard bookkeepers' oak desk, such as may be purchased of any commercial furniture dealer, but with the legs shortened to accommodate a person seated. The ample drawer room will be appreciated by all designers. The views are taken in the St. Louis City Hall, Department of Public Works.

FIG. 1. DRAFTING ROOM, SEWERS AND PAVEMENTS, CITY HALL, ST. LOUIS, MO.

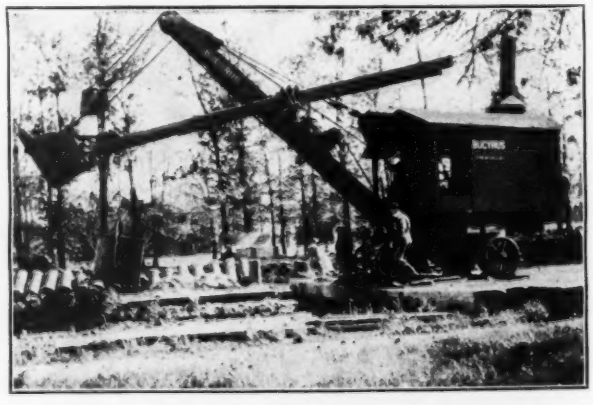
FIG. 2. COMPUTER'S AND ESTIMATOR'S DESK

## NOTES

**Mixing Cement with Skim Milk**—An item has been given wide publicity, to the effect that the inflammability of shingle roofs will be greatly retarded if they are given a coating of paste made by mixing skim milk and portland cement. It is doubtful whether any coating of this sort spread upon a shingle roof in sufficient thickness to materially affect its resistance to fire would not soon crack off by the gradual exposure and weathering of the shingles. It is a fact, however, that a very cheap cold-water paint for farm buildings and similar purposes can be made by mixing lime and portland cement with skim milk instead of water. The basis of the commercial cold-water paints is casein, which is substantially skim milk with the water removed. The main advantage of the casein appears to be that it holds the moisture until the cement has time to set, whereas a mixture of cement and lime with water, spread out in a thin coat with a brush, will dry before the cement has time to set. Ernest McCullough of Chicago informs us that concerns in Iowa have been putting cement paints on the market for a number of years, made up with skim milk according to a formula given by Mr. McCullough in an address in Minneapolis some ten years ago and the addition of some dyes or pigments to give a desired color.

**Contractors' Stern-Wheel Gasoline Barge**—With 26 dipper dredges excavating 625 mi. of ditch in the Little River Drainage District, Missouri, extensive use is made of small gasoline stern-wheel towboats for distributing coal and supplies. One of these boats which are built on the work by the different contractors, is described by P. J. O'Connell, General Superintendent of the Canal Construction Co., Memphis, Tenn. The hull is an open flat-bottom scow 36x8½ ft. on top, 3 ft. 2 in. deep. The frames have 6x6-in. posts and sills, spaced 25 in. c. to c., upon which is spiked the planking. The wheelshaft is carried by the projecting ends of long timbers, or wheel-arms, bolted to the tops of the frames. There are from 6 to 12 blades, according to the size of the boat. Light posts support a roof and hinged side panels, while at the forward end are a pilot house and an engine room. Some of the boats, however, have simply an awning roof of plank or corrugated iron, with the engine placed at any convenient point on the floor. The steering wheel and engine-control levers can be either at the bow or at the stern. Mr. O'Connell's boat has an 8-hp. gasoline engine of the ordinary single-cylinder horizontal type, with chain drive to a countershaft from which there is a chain drive to a sprocket wheel on the wheelshaft. It can make a speed of 3 mi. per hr. when towing a barge loaded with 50 tons of coal.

**Sewer Trenching** with a small revolving steam shovel, working from a platform of 12x12's over the trench, was done with apparent efficiency and economy on a recent job in St. Paul, Minn. The outfit is shown in the accompanying view. Only six men composed the construction crew. The



SMALL REVOLVING SHOVEL SEWER TRENCHING, ST. PAUL

12x12's were laid on planks on either side of the trench. All the excavation was done with the aid of the steam shovel. For finishing the grade and bailing out water a cylindrical bucket was attached to the dipper arm. This was filled with a shovel by a man in the trench, who also did the pipe laying. The trench contractors were Siems-Carey Co. & Helmers, St. Paul.

# Editorials

## Railway Rates That Help Cities at Expense of the Country

The authorities of the State of New Jersey have brought before the Interstate Commerce Commission a suit that raises questions of greater social and economic importance than any railway-rate case before that body in many years. The suit is brought to compel the railways reaching New York from the West to charge a lower rate on freight to or from the cities on the New Jersey side of the Hudson River than the charge to or from New York itself.

The issue is this: The present system of railway rates is based primarily upon distance. It harks back to the time when the railway was the competitor of the stage-coach. The cost of hauling over the road was then the main expense in transportation, and the cost of handling at terminals was trifling. The last half-century has revolutionized these conditions. The cost of hauling traffic over the road has been reduced to a mere trifle, while the cost of handling in the terminals of great cities has been multiplied many fold.

Everyone recognizes that transportation rates should be based on the cost of service plus a fair profit to the transportation company; but the present railway rates entirely ignore the high cost of terminal handling in large cities. Freight rates on a carload of goods hauled between Chicago and a factory located in Newark, Paterson, Jersey City or Hoboken are the same as if the freight had to be lightered across the Hudson River to or from a factory on Manhattan Island or in Brooklyn. Since railway rates must on the whole be sufficient to pay all the operating expenses, fixed charges and profits of the railways, it follows that the merchants and manufacturers of Jersey City, Hoboken and Newark are actually paying in their freight rates part of the cost of carrying goods for their competitors located on the eastern side of the Hudson River.

The average cost of transferring freight by lighters across the North River to New York City was estimated by an able expert six years ago at 80c. per ton. It is doubtless much higher now—because of the increase in labor and material prices in that time. There must be added to this expense the cost of the switching movements on the New Jersey side of the river to sort the cars for placing on the car floats. It is probably safe to say that it costs the railways that cross New Jersey from $1 to $1.20 per ton more to handle freight to and from New York or Brooklyn than it does to handle the same freight to or from a private siding of a manufacturing plant located in Newark or Paterson. Yet on goods shipped a hundred miles or more westward the Newark shipper must pay the same rate as the New York shipper.

It has long been recognized that for the economical handling of Western freight at the port of New York the transfer should be made directly between cars and ocean steamers on the New Jersey side of the North River. The cost in rehandling, trucking, switching, etc., where steamships land at the crowded wharves of Manhattan and Long Island, before a consignment of goods is started on its railway journey westward constitutes a tax on business that is felt by industries scattered all over the United States. But so long as the present artificial railway rates prevail, shippers would have no object in directing their traffic through a New Jersey terminal if one were built.

In other words, the present rate structure perpetuates an expensive method of doing business involving an expenditure of many million dollars annually, which is added to the price of a thousand commodities distributed to many millions of consumers.

There has already been from other causes a great development of manufacturing industry in that part of New Jersey within a radius of twenty miles from New York. The high cost of land in Manhattan and Brooklyn, the congestion of street traffic, with the heavy cost of cartage, have already driven most of the heavy manufacturing industries out of New York City to locations in New Jersey. There is no reason whatever why these hundreds of manufacturing concerns and the hundreds of others which are certain to locate there during the next dozen or twenty years should not be granted railway rates corresponding to their advantageous location instead of being burdened as they now are with a rate based on the cost of transferring all freight across the Hudson River.

It need hardly be said that this suit will be bitterly contested. New York City interests will fight any proposition that might encourage the transfer of commerce and industry to the New Jersey side of the river. The owners of real estate in every city constitute the most influential interest; and there is no city where population is so congested and land values so high that the real-estate interests will not exert all their influence to favor anything that promises to force land prices still higher.

New York at present stands committed to a gigantic real-estate speculation in building up a great ocean-freight terminal at Jamaica Bay, in the eastern part of Brooklyn. The cost of transferring freight between this Jamaica Bay terminal and the railway lines west of the Hudson would be as great as the cost of hauling it hundreds of miles on its journey westward.

Doubtless the New York situation is the most flagrant case of discrimination to be found anywhere due to the ignoring of terminal costs in fixing railway rates; but the principle involved is of great importance to the country as a whole. There is no doubt whatever that the present system of railway freight rates, which takes no separate account of terminal costs, is a powerful economic force in stimulating the congestion of manufacturing, commerce and population in great cities and handicapping the business of the country towns and the smaller cities.

It is doubtless little realized, even by engineers, how great the disparity has become between the cost of haul-

ing freight over a railway when once started on its journey and the cost of handling it in crowded city terminals. In *Engineering News* of Mar. 3, 1910, there were presented a detailed analysis and figures comparing the average cost of road haulage with the cost of handling freight at the terminals of New York City and Philadelphia. It may be of interest to repeat here some of the figures given in that article.

An estimate was made of the average cost of handling a ton of merchandise freight between a warehouse in Philadelphia and a store in New York City. The total terminal expenses at the two ends of the route were found to be $3.65, whereas the total cost of hauling the ton of freight over the ninety miles of railway between the two cities after it was once started on its journey was only 27c. In other words, on that class of freight, handled between these crowded city terminals, *the cost of hauling over the road was only one-fourteenth as much as the terminal cost.*

A second comparison was made of the average cost of handling through merchandise freight between Chicago and New York City. It was there shown that, according to the best figures obtainable, it costs the railways about as much to handle this freight in the terminals at each end as it does to haul it the entire thousand miles between the two cities.

It is especially important to remember that while the tendency of modern transportation methods is toward a steady reduction in the cost of haulage over the road, the terminal expenses, on the other hand, are all the time increasing, and increasing especially fast in the larger cities. The land in large cities used for switching yards, team tracks and freighthouses is steadily rising in value. The bigger a freightyard grows, the longer is the distance cars have to be moved in it in sorting and making up trains. The bigger a freight warehouse becomes, the longer the distance the trucks have to travel in handling incoming and outgoing freight.

It is probably not often realized that in the development of our present-day railway transportation system the engineer is dealing with problems wholly without precedent. The world has never before seen cities of such vast size; never before has the problem arisen of furnishing economic transportation to such huge aggregations of people.

How much farther can we proceed in our concentration of population? The railways have spent many hundreds of millions to create their present city-terminal facilities. How vast must be their expenditure if switching yards and freighthouses must again be radically enlarged on land purchased in congested districts? There is little doubt that one of the greatest factors in the high cost of living is that so large a proportion of the population is crowded on high-priced lands.

The freight congestion of the past six months has been a great object lesson, showing how small is the safety factor of capacity in our great city railway terminals. It is there that the congestion has been concentrated. There has been no difficulty in moving trains over the road, even on the lines where freight embargoes have been most frequent. The difficulty has been in sorting the cars in the crowded yards when they arrived at their destination.

The expense that railways and shippers have incurred during the past nine months because of the congestion of railway traffic must amount to many million dollars. That a vast investment must be made by the railways in enlarging city-terminal facilities is beyond question. It is time to take a long look ahead and see what can be done now to reduce the need of this in the future.

It would be of enormous advantage to the railways to stimulate the growth of industry and traffic at the smaller cities, where their terminal expenses are small and their profits are correspondingly large. The railways could do this in no other way so certainly as by radically revising their rates so that the shipper in the great cities will have to pay the cost of the service rendered him.

It would be of vast advantage to the country, also, to have some check applied to the congestion of population, with all the social and economic problems connected therewith. The figures previously given as to the relative cost of road haulage and city-terminal costs give some idea of how radical the change would be if railway rates were revised to correspond to the cost of service.

It is, however, beyond expectation that any such revolutionary change will be made save by slow degrees. The advocates of such a change would be opposed by the city real-estate interests the country over. A great majority of present shippers now located in the cities would of course join in opposition. The railways also, from pure conservatism, would doubtless oppose so sweeping a reform, although nothing can be clearer to traffic experts than that the present plan of practically ignoring cost of service in fixing rates is pernicious in principle and distributes the transportation tax most unfairly.

Manifestly, a long process of public education must precede the needed reform, and it is to be hoped that the suit brought by New Jersey may be a first step in this process.

## Co-operation Saves Pavements

Much has been written about the vicissitudes city pavements undergo because of constant openings to get at subsurface pipes, conduits, etc. Paving engineers lament the necessity of these openings, and many cities have passed stringent ordinances setting a definite time of from one to five years during which a new pavement must not be disturbed except for emergency work. But Chicago appears to be one of the first, if not the first, city to meet the problem in a rational way.

In Chicago there is an organization known as the Board of Underground Work of Public Utilities, the purpose and labors of which are apparently little known to municipal and public utility officers generally. It is not a new thing, for it has had five or six years' successful operation to prove its worth.

This board of Underground Work of Public Utilities is an association of the Board of Local Improvements, the Chicago Postal Pneumatic Tube Co., the Chicago Telephone Co., the City Electrical Department, the City Press Association, the City Water Department, the Chicago Surface Lines, the Commonwealth Edison Co., the Peoples Gas Light and Coke Co., the Postal Telegraph Cable Co., the Sanitary District of Chicago and the Western Union Telegraph Co. In short, the association comprises all the public utility interests of the city sharing in the use of the streets. These interests are represented in

the Board by their chief engineers or other officials. The Board has a salaried secretary whose office is in the City Hall adjacent to the offices of the Board of Local Improvements.

The object and work of this Board is to save the city pavements from avoidable openings. The secretary of the board is constantly on the job to find out when and where new pavements are to be laid. He then brings to the attention of the interested public utilities any changes in their subsurface structures which are necessary or desirable before the new pavement is laid. He keeps posted on whether or not these changes have been made before paving operations begin. In short, he is the go-between by which results are accomplished without the usual governmental and bureaucratic red tape and misunderstandings. The secretary has no authority to order work done, nor does he devise ways and means to do it. That is the work of the responsible bureau or corporation officials.

Aside from eliminating red tape by means of the secretary, the regular meetings of the Board and the intimate association and acquaintance of the public utility heads with one another has worked wonders in bringing about a better understanding of the objects to be attained and in bringing about a really hearty coöperation between what were, and in many cities still are, warring interests.

## The Old Battle Between Stone Masonry and Concrete

Engineers whose memory extends back over a period of twenty years or more will readily recall the strong prejudice that for many years retarded the use of concrete in the United States. French engineers built notable structures of *béton*, as they called it, in the early '80's, but all through the '90's American engineers, particularly those of the older generation, were doubtful of the reliability of concrete and hesitated to risk their reputations by building concrete structures.

One of the most prominent among the opponents of concrete was the late William H. Brown, for many years the Chief Engineer of the Pennsylvania R.R.; and one of his remarks with reference to concrete gained wide publicity. He declared that for his part he could not see the advantage of breaking stone up into little pieces for the sake of sticking it together again with cement. As long as he remained at the head of the Pennsylvania's engineering department, that company consistently avoided the use of concrete except for footing courses.

Under Mr. Brown the policy was inaugurated of building stone arches in place of metal or wooden structures of moderate span all along the main line of the Pennsylvania R.R., as well as on other divisions of heavy traffic. Probably few will be found to question the soundness of this policy, and it is altogether likely that most of these bridges will be in sound condition and amply strong for the loads imposed upon them a century after their completion.

There are, however, exceptions, and it is of interest to record that extensive repairs became necessary last spring to one of these stone-arch bridges built no longer ago than 1899. The bridge in question is a five-span stone arch, crossing the Little Juniata River in the Spruce Creek Narrows east of Tyrone, Penn. The arch is on a very sharp skew and is of the ribbed type. Longitudinal cracks developed on the under side of these ribbed arches, indicating that the outer rings had separated from the body of the arch, and it was deemed necessary to adopt means for bonding the arch longitudinally and preventing further separation.

In order to do this without interrupting traffic, long yellow-pine timbers were placed under the ties, enabling pits to be excavated in the filling on top of the arches without interfering with the stability of the track. In this way the arches were exposed, and holes were drilled in the backs of the arch stones. Iron rods were inserted in these holes in such a manner as thoroughly to bond the arch together and draw the separated rings back into place. After these bonding rods were placed, they were embedded in concrete, which at the same time of course further secured the arch rings. According to a detailed report of the work in a local paper, about four months' time was consumed in making these repairs, and there were used in the work 56 timber stringers, 12x18 in. by 46 ft.; 1,685 cu.yd. of filling on top of the arch was excavated; 2,110 bonding holes were drilled in the arches, each 1¾ in. in diameter and 8 in. deep. It will be evident from the foregoing that the structure as now repaired has a very substantial reinforced-concrete mat on top of the stones arches, and is without question a much stronger and more secure structure than when originally built.

It might be a reasonable conclusion to draw from this experience that for arches built on a very sharp skew a good concrete structure is more reliable than cut stone. It would not be safe, however, to draw any such conclusion as regards the relative merits of concrete and stone masonry as applied to structures generally. No engineer doubts nowadays, of course, that a concrete-arch structure properly designed and properly built is safe, reliable and permanent. There is some danger, however, that with the great popularity and extensive use of concrete the merits of cut-stone masonry and its advantages in certain locations are in danger of being overlooked. There are certain economic advantages in breaking stone into little pieces and sticking them together again with cement which were not appreciated by Mr. Brown and others who held similar views twenty-five years ago. On the other hand, in localities where good dimension stone, readily cut, is easily obtainable, the masonry arch should find a place, and its design and construction ought not to become a lost art.

## Another Public Health School

The recent announcement of the establishment of a School of Hygiene and Public Health at Johns Hopkins University, Baltimore, by the Rockefeller Foundation, is an act as well designed as anything can be "to promote the well-being of mankind throughout the world"—the motto and the grand object of the Foundation.

Strange to say, none of the justly commendatory press comments on the establishment of this school mention the fact that a number of schools of public health are already in existence and doing good work in the United States. Stranger still, the press announcement given out by the Rockefeller Foundation was silent on this point, although it distinctly said:

**There are many medical colleges in the United States which train men for a career in curative medicine, but the facilities for those desiring to devote themselves to preventive medicines and the promotion of public health are yet inadequate.**

It would have been only fair to recognize the existence of a number of schools of public health and to have stated that there seemed to be plenty of room for another. Failure to do this may be passed over as an indication that neither the publicity bureau of the Rockefeller Institute nor the daily press wished to detract from the news interest of its story by acknowledging that it was not announcing something unique in the annals of the United States.

Turning now to another phase of the announcement, or rather to the foreshadowed character of the school itself, it is a pleasure to recognize that instruction in sanitary engineering is prominently featured and that attention is to be given to social science and its relation to public health. It is notable that the announcement states that on its teaching side the school "will be designed primarily to benefit those who plan to give their lives to the administration of scientific sanitation." Stress is rightly put upon instruction in sanitation rather than in medicine.

Certainly from the administrative point of view, public-health work is sanitary rather than medical in character. But is not too much emphasis being laid upon instruction in both medicine and engineering by most of the schools of public health today?

Under the present precarious tenure of municipal office it may be necessary for the health officer to be able to turn either to medical or engineering practice for a living at any time. This necessity ought not to continue long. When it ceases and when the hundreds of municipalities of the country realize the value of the services of trained health officers and are willing to employ them and keep them during good behavior and efficient service, then certainly there should be a new sort of public-health school which would cut out a considerable part of the instruction in both medicine and engineering that now seems to be deemed necessary. Health officers may then best be trained broadly in the fundamentals of public health and sanitation, sociology, law, vital statistics and especially in administration. They can and will then call to their aid, as needed, specialists in medicine, in sanitary engineering, bacteriology, chemistry and other sciences, instead of taking a specialist in one of these fields for a health officer or for material to be put through a school of public health.

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## Low Bids for Another East River Tunnel

The low bids received by the New York Public Service Commission last week for two subway tunnels to be driven under the East River, from 60th St. in the Borough of Manhattan, to the Queensboro Bridge Plaza in Long Island City, about 1½ mi., are especially noteworthy in view of the troubles which have been met in previous East River tunnel driving. Most engineers around New York are familiar with the accidents and delays that have been met with in the construction of the ten tunnels which have already been driven under that river. It is safe to say that nowhere else in the world is there another body of water under which tunnels have been driven with such extraordinary difficulty and danger. The most recent and most spectacular difficult tunnel driving under the East River was the new gas tunnel at 132nd St. which was fully described in *Engineering News* last fall. This is a deep tunnel in rock, 250 ft. below the surface of the water.

The tunnels to be driven at 60th St. will be as near the river bottom as practicable to reduce the total rise and fall. A mile farther south are the two old Steinway tunnels, which were taken over and put in operation by the city as part of the underground rapid-transit system a year ago. It is of interest to note that the corporations which built the Steinway tunnel claimed to have expended about ten million dollars on their construction, whereas they were turned over to the city at about three million dollars.

A short distance farther south are the four tunnels which carry the lines of the Long Island R.R. under the river to the Pennsylvania station at Seventh Ave. These tunnels were built under the direction of the late Alfred Noble, as engineer, with the Pearson Co. as contractor. Many will recall the huge fountains of escaping compressed air that arose from the surface of the river over the tunnel headings for months while this work was going on. Similar, if not worse, difficulties were experienced in driving the pair of tunnels across the river from the Battery which are used by the present subway trains. Indeed some of the ground through which these tunnels pass is so soft that for years after the tunnels were opened, there was agitation from time to time over reports that the tunnel structure was becoming displaced in the silt.

For the four tubes a short distance above the Battery tunnels which will form the downtown crossover connections of the new subway system and which are now under construction, the bid price was in the neighborhood of $13,000,000, a very much greater price per track, it will be seen, than the low bids now made for the 60th St. tunnels. Various difficulties have been experienced on these downtown tunnels since work was started there, but probably no more than was expected by the contractors when they prepared their bids.

Possibly one explanation of the low bids on the 60th St. tunnels is the expectation that tunneling conditions there will be more favorable than at other points on the river. As the tunnel crosses directly under Blackwell's Island, it will be in solid rock, presumably, for a considerable part of its length. It is fair to assume, also, that the channels on either side of the island, which are subject to perpetual tidal scour, will contain less of soft silt than the wider stretches on the river below.

There will be, however, on each of the 60th St. tunnels, presumably, at least four points where a change from earth to rock will have to be made, with all the difficulties that involves. Furthermore, as the East River gas tunnel experience shows, the rock in that vicinity is very far from reliable for tunneling work. The high prices of labor and materials now current make the low bids for the East River tunnel the more remarkable.

Finally it must be noted that not one contractor but several were of the opinion that the 60th St. tunnels could be built at a low price and backed their opinion with their bids. When the petition was presented a year ago to have the uptown subway connection made across the river by a tunnel instead of by strengthening the Queensboro cantilever bridge to carry additional loads, the Degnon-McLean Co. offered to build the tunnel for not to exceed $4,500,000, if given a chance to bid. When it came to actual bidding, however, this company bid more than a quarter of a million dollars below its guarantee, and one other bidder went lower still.

# Letters to the Editor

## Montreal Centrifugal Pump

Sir—In commenting upon your discussion of the recently published test of a De Laval steam-turbine-driven centrifugal pump at the Montreal Pumping Station, F. W. Dean, in your issue of June 8, makes several questionable assertions. He says: "I think that every effort should be made in such matters to see that pumping engine guarantees are based upon the performance of the main engine, unmixed, so to speak, with auxiliaries."

What the purchaser generally desires is the most economical plant, which should govern the kind of guarantees to be drawn. Other things being equal, in a steam-driven plant, is not that prime mover, or combination of prime mover and auxiliaries, the best that will produce the highest overall duty; that is, the most foot-pounds of work from a given amount of heat? If the cycle of operations can be improved by designing the apparatus to work in conjunction with auxiliaries, why should it not be done and why should not the auxiliaries be included in the guarantees and in the acceptance test?

Mr. Dean further says: "It has been my custom, and it should always be the custom, to base the performance upon the steam used by the engine itself, as a measure of the merits of the engine and means of comparison with other engines." The test conducted by the Montreal Water-Works engineers, however, was not intended to measure the efficiency of an engine. Its purpose was rather to determine the duty of a complete outfit, as measured by its ability to utilize heat in raising water. It was agreed with the builder therefore that the net amount of heat received from the boilers would be used in calculating the duty as explained in the report of the acceptance test that was supplied to the *Engineering News*.

The fact that the quantity of heat was defined in terms of 1,000 lb. of steam at a stated temperature and pressure, produced from cold feed water of a certain temperature, rather than in millions of B.t.u., does not alter the situation.

The weight of steam entering a turbine is not of itself a suitable measure of duty in a pumping plant as ordinarily designed. For example, a perfect engine, expanding adiabatically from 150 lb. gage to 28 in. vacuum, would develop 224 million foot-pounds per million B.t.u. received from the boiler, or 252 million foot-pounds per 1,000 lb. of steam. On the other hand, an engine working on an isodiabatic cycle in which partly expanded steam is employed to heat the feed water up to boiler temperature, to which the use of an exhaust steam feed-water heater is an approximation, would have a duty of 250 million foot-pounds per million B.t.u., but of only 314 million foot-pounds per 1,000 lb. of steam entering the engine. The reheating engine draws more steam from the boiler, but some of its heat is put back, so that actually less heat is required from the fire, and less fuel is burned.

GEORGE H. GIBSON.

Tribune Building, New York City, June 15, 1916.

Sir—I have been greatly interested in the article and the subsequent discussions concerning the Montreal centrifugal pump. I believe, however, that the published letters create an erroneous impression, when they appear, as they do, by themselves and are read by engineers who have not seen the original article that appeared in *Engineering News* of April 27.

The article that has received so much adverse comment does not appear to be misleading in the slightest degree, for it distinctly warns the reader that heat returned by the feed-water heaters is credited in the duty figures, and this is certainly as it should be, for the ultimate economy of any heat unit is measured by the conservation of the heat supplied it; and conversely, the extravagance of any unit is measured by the total heat actually extracted from the system. The time is passing when engineers are content in getting only the highest mechanical results from steam, then letting all the heat that cannot be converted into mechanical energy go to waste in the condenser. If the American Society of Mechanical Engineers' Test Code discourages anything that conserves the heat of a system, it would seem that it should be revised. Further, engineers are more interested in the ultimate steam consumption of a system than they are in the consumption of a particular part that obtains its greater economy partly at the expense of some other unit of the system, such as the boilers.

If the steam turbine lends itself to the further use of partly expanded steam in feed-water heaters better than does the reciprocating engine, it certainly should not be barred from enjoying this inherent advantage by an arbitrary test code.

With reference to the editorial in *Engineering News* of May 18, entitled "Triple Expansion Still Ahead," I think that the editor has presented the case in an improper light. The duty claimed for the Montreal unit is 168.3 million foot-pounds per thousand pounds of steam at 140 lb. pressure and 100° F. superheat. This certainly is not, by any manner of figuring, equivalent to 168 million foot-pounds per million B.t.u. as stated in the editorial and no such figure was claimed nor could any one infer from the original report that such was the case. The figure of 134 million foot-pounds per million B.t.u. actually extracted from the system gives the correct measure of the economy of the Montreal installation, and represents what any other unit would have to meet in order to equal this ultimate economy. If, in a comparison between steam turbine and reciprocating units, credit for heat returned to the system is not allowed the turbine unit, it is manifestly unfair to the turbine, not to charge against the reciprocating unit the additional work put on the boilers, by evaporating from a colder feed temperature.

As stated in the foregoing, the published letters, appearing by themselves, prejudice the reader. For instance, F. W. Dean's letter of June 8, relates a case of a reciprocating unit where credit was wanted for the

steam used in the cylinder jackets. This illustration is particularly unfortunate and far from comparable with the case under discussion. Here, we are asked to credit a machine with heat actually extracted from the system in obtaining its economy and the casual reader at once infers that some similarly unwarranted credits are claimed by the Montreal unit, whereas, in the case under discussion, the turbine is charged with absolutely all the heat that it removed from the system.

The steam turbine has brought with it new ways of arriving at better efficiency and these better efficiencies cannot always be determined in the old ways, and the old ways of expressing economies are often extremely misleading. There are many cases where a straight high-pressure condensing machine is absolutely extravagant when compared with the bleeder turbine, although the steam consumption of a bleeder turbine in pounds per kilowatt-hour is ridiculously high when compared with the condensing machine. How, then, are we to express the economies in such instances? Not by steam rates, for they are misleading. The logical way, to my mind, is to base all duty statements on the actual heat removed from the system, for manifestly any heat that remains in the system is not consumed. This will eliminate, to a degree, such variables as steam pressures and superheat that make the usual duty records hard to compare unless all the data are available.

In the case of the Montreal unit, the above method was used to a certain degree and adds another precedent for the newer and more exact method of determining duty; and instead of causing so much adverse criticism it should be considered as the forerunner of more modern methods that are bound to supersede the antiquated methods now in vogue. R. A. Burford, Jr.

131 State St., Boston, Mass., July 1, 1916.

[What we have criticized is not any improvement in pumping equipment or test methods, nor any contract basis found desirable by builder or purchaser. What we did mildly censure was the statement that the duty of the Montreal pump was 168.3 million foot-pounds per 1,000 lb. of steam, when that rating did not correspond to the widely accepted meaning given by the test-report code of the American Society of Mechanical Engineers—even though to that figure was appended an explanation (sure to be omitted sooner or later by some one) of the difference in meaning. The advances in overall efficiency of large turbine-driven centrifugal water-works pumps are each and all matters of unusual interest and importance; the greater this interest the greater is the need for announcing the accomplishment in unmistakable terms. No matter what tests are agreed upon between builder and purchaser, in an important case data should also be sought that will permit full comparison with earlier machines.—Editor.]

## Creeping and Heaving of Concrete Road Slabs

Sir—I have just read with much interest the editorial on the creeping and heaving of concrete road slabs in the issue of June 22, p. 1192, in which suggestions are requested from engineers who have worked in the field of concrete-road construction.

The four cardinal faults of concrete roads have been in nearly all cases traced to (1) poor drainage of subgrade, (2) porosity of the concrete, (3) non-uniform abrasive value in the wearing surface, (4) improper curing.

Overcoming the first fault is elementary. If the subgrade is permitted to become saturated with water, it will heave and swell in both northern and southern climates, this being especially true if the subgrade was over-rolled or over-compressed when dry. A subgrade can be over-rolled as easily as under-rolled, and to prevent over-rolling I recommend a 6- or 7-ton roller.

The porosity of the concrete is one big obstacle to overcome in a concrete pavement. Get the concrete as dense as possible, for the absorption of moisture swells the concrete and sets up internal stresses that are very damaging, causing it to crack and disintegrate. The concrete should be laid too dry rather than too wet. It should come from the mixer in a quaking homogeneous mass. If the mix is too wet, the water will soon drain down into the subgrade and take a large portion of the cement with it.

In almost every case, the parting of the two slabs of concrete is not due to subgrade faults, but to the absorption of moisture in the slab, which causes the concrete to swell. Should this state be followed by a few hot days, the slabs would dry out and contract, leaving a slight open joint between slabs. This crack or joint will at once be filled with dust, sweepings or other incompressible material. This intermittent swelling and contracting, followed each time by the entrance of foreign matter, will gradually increase the width of the joint or crack and force the slabs out of place. By this is not meant that no pavement creeps on subgrade, but that in most instances the separation of the concrete slabs is due to expansion and contraction and not to creeping.

Regarding the non-uniformity of the wearing surface, it is certainly the better part of wisdom to get as dense and rich a mixture of stone and mortar as possible in the top surface, which will not only improve the wearing quality of the pavement, but to a large extent form a water-tight covering. This can be done by a more thorough floating and tamping, and it is a point of such tremendous value that too much stress cannot be laid on it in all concrete-road specifications.

Frank W. Sampson.

Katonah, N. Y., July 10, 1916.

## NOTES AND QUERIES

**Aërial Tramways on the Los Angeles Aqueduct**—The use of aërial tramways in the construction of the aqueduct for Los Angeles, Calif., was described in "Engineering News" of June 29. It should have been stated that two of the three tramways were built by the American Steel and Wire Co., of New York, N. Y., and the third by the A. Leschen & Sons Rope Co., of St. Louis, Mo.

**The Article on Steel and Wood Water Mains** at Butte, Mont., published on p. 1108 of our issue of June 8, stated that the first wood stave pipe line laid in Butte which was of redwood pipe, was put down in 1892 and was still in good condition, and that over 40 mi. of continuous stave wood pipe had been laid since that time. It might have been inferred from the wording of the article that all this wood pipe was of redwood. We are informed, however, that two of these wood conduits are of fir staves, one of them laid many years ago and the other about three years ago.

# New Facts About Materials and Methods of Test

Some of the papers and discussions relating to properties and tests of materials read at the Annual Meeting of the American Society for Testing Materials were presented in these columns last week. Below are given others of practical interest.

## Two Ways of Testing Cloth

The existence of two quite different methods of testing cloth in tension was emphasized by the Textile Fabrics Committee in recommending one method for belting fabrics and another for tire fabrics. Fig. 1, from a short paper by W. S. Lewis, gives the essentials of the respective test pieces.

For the "strip" test the cloth is raveled to 1-in. width and the test thus made on a definite thread-width. For the "grab" test a wider strip is used, but the jaws that grip it are only 1 in. wide. Mr. Lewis gave a long table

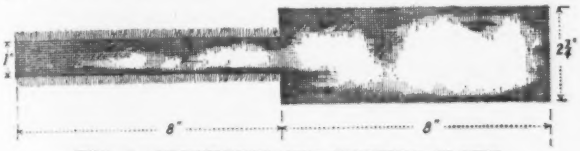



FIG. 1. SPECIMENS FOR TESTING CLOTH
Left—Strip test Right—Grab test

of test results on wool and cotton fabric, showing that the grab method indicated up to 127% greater strength than the strip method.

E. D. Walen discussed the actions of the two test pieces during test. Fig. 2 represents the behavior of the threads near failure. In the strip test some of the outer threads pull away and do not get tension enough to break. In

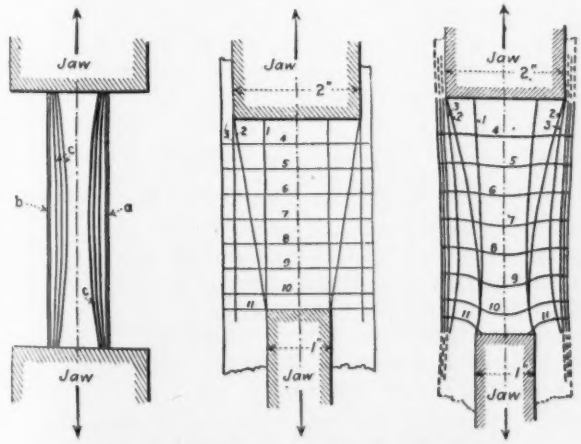



FIG. 2. RESULTS OF CLOTH TESTING
Left—Strip test specimen before breaking. Middle—Grab test specimen before testing. Right—Grab test specimen just before breaking

the grab test a larger width of cloth than the jaw width participates in the resistance.

If either test is a true measure of strength of the material, it should for varying width show proportionally varied strength. Tests bearing on this point yielded the curves reproduced in Fig. 2. These show that the strip test follows a straight-line law, while the grab test follows a curve.

Variations from the linear law, occurring in duck fabrics, were discussed by John Lind and E. D. Walen. Corrections must be introduced to allow for the number of unbroken threads in wide test pieces—the number being constant after a certain minimum width—and for the greater coöperation of the whole test piece in very narrow widths, when the pull is able to straighten out the thread.

## Testing Refractory Firebrick

C. E. Nesbit and M. L. Bell submitted practical methods for testing refractory firebrick. They consider that, to be of greatest benefit, the tests should be such that they may be readily made on the finished brick, and their investigation, which is reported in the paper, was to develop tests that would imitate service conditions and give information from which the quality of the brick could be determined. The method for making the tests, written in the form of a specification, is appended to the paper. It is stated that the methods described are primarily intended for testing brick about an iron and steel plant, but it is believed that they can be easily modified to fit the requirements of brick in other industries.

## Wear Tests on Concrete

Acting on the premise that wearing resistance is a function of hardness, toughness, brittleness, etc., Prof. D. A. Abrams, of Lewis Institute, Chicago, has been experimenting on the wear of concrete blocks placed around the perimeter of the Talbot-Jones rattler, in which fixed brick are subjected to battering action. Test blocks 8 in. square and 5 in. in thickness are arranged around the drum of the rattler and subjected to the abrasive action of a charge of 200 lb. of cast-iron spheres. About 200 blocks have been tested with helpful results. Professor Abrams considers that all things are favorable to this method of test and thinks that it may prove of considerable value in studying the relative merits of different aggregates, mixes, consistencies, time of mixing, surface treatment, etc., on the wearing resistance of concrete, particularly in relation to the construction of floors.

In discussion George P. Hemstreet (Hastings Paving Co.) said that a device similar to that described had been in use for ten years in the asphalt block industry and had yielded most excellent results.

## Strength of Clamp Splices in Reinforcement

The strength of reinforcement-bar splices made with U-clamps was reported by E. L. Lasier. Mr. Lasier made a number of tests of three types of reinforcement splices—namely, lap splices not embedded in concrete, butt splices not embedded in concrete, and lap splices embedded in concrete, 1-in. square cold-twisted reinforcing rods being used. The lap splices consisted of two bars overlapping each other 17 in. and 21 in., with the ends clamped with U-clamps. The butt splices consisted of two rods butt-

ended and overlapped with another bar extending 17 in. in one case and 21 in. in the other on both rods, clamped thereto with the regular U-clamp. It was found that the 4-in. difference in length of lap tested had apparently no effect on the strength of the splice, that the clamp lap splices when they were not embedded in the concrete sustained a slightly greater load before the first slip and a larger maximum load than the clamp butt splices; that the splices consisting of two bars of opposite twist probably sustain a greater load before first slip and a larger maximum load than do splices in which the bars have a like twist; that lap splices are stronger than butt splices; that the clamp lap splices embedded in concrete undoubtedly can safely withstand a unit load equal to the unit stress in steel reinforcement.

## Emulsification Value of Lubricating Oil

P. H. Conradson described a simple test method for comparing oils as to their power to separate out from a water emulsion, or demulsify. A 250-c.c. graduated glass cylinder, about $1\frac{7}{16}$ in. in diameter, is charged with 20 c.c. of distilled water and 100 c.c. of oil. Then steam is passed through to churn it, for 10 min., and the cylinder is kept 1 hr. in a water bath at 130° F. At the end of this time the graduations permit reading off the volume of separated water, the volume of emulsion and the volume of separated oil (on top). The amount of water in the separated oil is also determined.

W. H. Herschel proposed a somewhat different method. He takes 20 c.c. of oil and 40 c.c. of water and, after heating them to 130° F., stirs them with a $3\frac{1}{2}$x$\frac{7}{8}$x$\frac{1}{32}$-in. metal paddle at 1,500 r.p.m. for 5 min. The mixture then stands at 130° F., and the rate of settling in cubic centimeters per hour is measured. The best transformer, dynamo and turbine oils settle out in a minute or less. The General Supply Committee of the Government specifies for turbine and spindle oils a demulsibility of at least 300 by Herschel's test, meaning that the entire 20 c.c. must separate out within 4 min.

## Proposed Specification for Concrete Aggregate

Realizing that the current specifications for concrete aggregate are anything but satisfactory, Cloyd M. Chapman, of Westinghouse Church Kerr & Co., proposes a new form of specification which he thinks may satisfy the first requirement of an acceptable specification—namely, that it should insure the production of suitable concrete if the aggregates are properly used. But it does not, he thinks, satisfy the second requirement, which is that the specifications should permit the use of materials found in the vicinity of the work, if such materials are capable of producing concrete of the required quality. He suggests that instead of specifying that a concrete aggregate, particularly sand, be of a certain fixed minimum standard of quality, which may not be obtained in certain localities, the specification should be made to read in effect as follows:

**The material used shall be of such quality and shall be used in such proportion as to produce a concrete which shall show a compressing strength of 2,500 lb. per sq.in. (or 2,000 or 1,500, as the writer requires) at the age of 28 days when tested in accordance with the standard methods of testing.**

Mr. Chapman shows how his firm has utilized this method of specification and has succeeded in getting a very good aggregate. The suggestion is in effect the same as has been made in a number of cases recently—that concrete materials should be tested on the results in the concrete mixture and not on their composition or behavior as separate parts of the mixture.

## Finding Specific Gravity of Aggregates

Prevost Hubbard and F. H. Jackson, Jr., presented a paper entitled "The Specific Gravity of Fine Homogeneous Aggregates," which outlined an investigation to study methods in common use or those which gave promise of being most satisfactory for the determination of apparent and true specific gravity of mineral aggregates such as are used in roadwork, concrete work, etc. Seven different methods were described and descriptions of the tests given in detail. The authors make the following conclusions:

**In the case of rock and slag an appreciable variation may exist between apparent specific gravity and true specific gravity, depending upon the absorption of the material. It is impracticable by any of the methods studied to determine the apparent specific gravity of samples composed of fragments smaller than ½ in. in diameter. Methods employing single test specimens are not safe to use for determining the specific gravity of nonhomogeneous aggregates, even when the average results of three apparently representative samples are taken; fragments not less than ½ in. in diameter for methods employing 1,000-gram samples are satisfactory. With extremely nonhomogeneous aggregates it is recommended that the average of not less than three tests be taken.**

## Data for Exponential Fatigue Hypothesis

Moore and Seely have compiled a new table of values of constant $B$ for the exponential hypothesis of fatigue, expressed by the formula

$$Stress = \frac{B}{\left(1 - \frac{min.}{max.}\right) N^{\frac{1}{8}}}$$

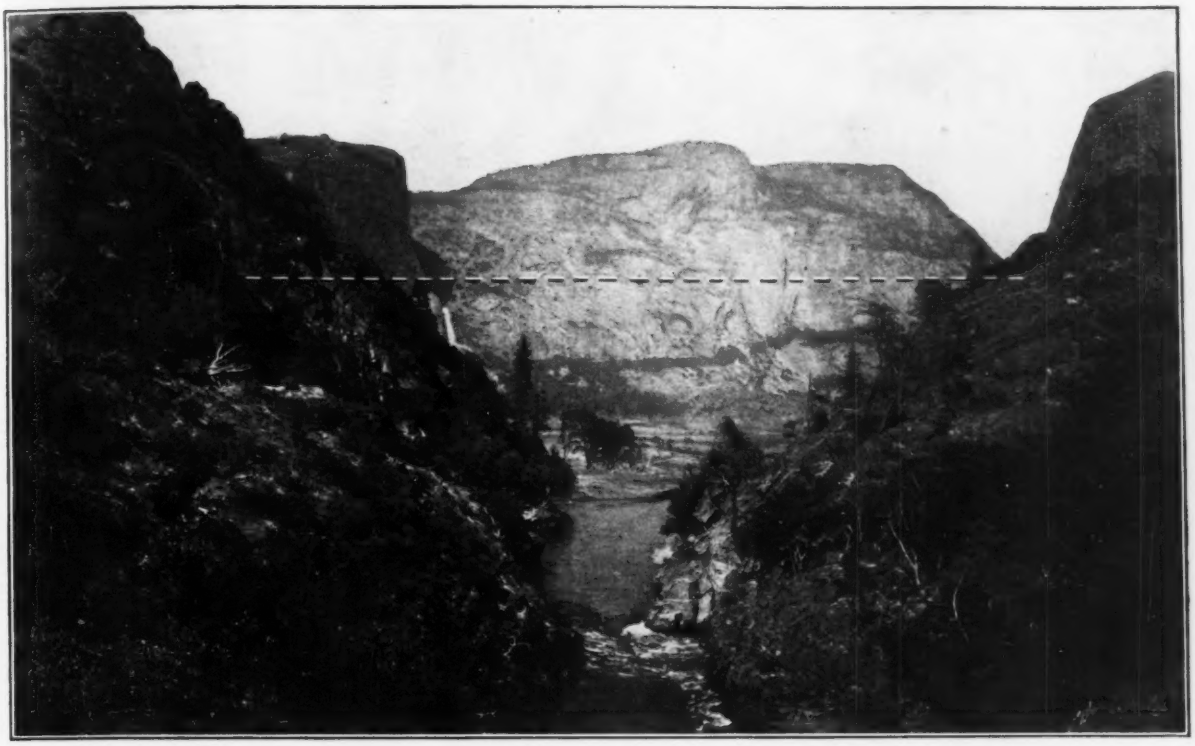
where $N$ is number of repetitions of stress producing failure, and $B$ is a constant. This table is based on test results covering only moderate numbers of repetitions. The whole hypothesis, however, is intended to replace the previously accepted view that there is a lower limit of stress at which infinite repetition will not produce failure. The present table of values, therefore, does not add weight to the hypothesis, but it is reproduced below.

The authors also gave two charts for solving the formula, but the formula is very simple to handle by logarithms. In cases where failure does not mean serious damage, the authors multiply the second term by the factor $(1 + 0.015N^{\frac{1}{8}})$, in which case

$$Log\ S = log\ B - log\left(1 - \frac{min.}{max.}\right) - \tfrac{1}{8}\ log\ N + log\ (1 + 0.015N^{\frac{1}{8}})$$

TENTATIVE TABLE FOR B, BY MOORE AND SEELY

| Material | B | Log B |
|---|---|---|
| Structural steel and soft machinery steel | 250,000 | 5.39794 |
| Wrought iron | 250,000 | 5.39794 |
| Steel, 0.45% carbon | 350,000 | 5.54407 |
| Cold-rolled steel shafting | 400,000 | 5.60206 |
| Tempered spring steel | 400,000 to 800,000 | 5.60206 to 5.90309 |
| Hard steel wire | 600,000 | 5.77815 |
| Gray cast iron | 100,000 | 5.00000 |
| Cast aluminum | 80,000 | 4.90309 |
| Hard-drawn copper | 140,000 | 5.14613 |



THE SITE OF THE HETCH HETCHY DAM AND RESERVOIR, SAN FRANCISCO WATER-SUPPLY
Line indicates crest of dam

## Hetch-Hetchy Dam Site

The accompanying view is one of the best that it has been possible to make of the site of the new Hetch-Hetchy dam on the projected water-supply for the City of San Francisco, Calif. The dam will be about 300 ft. high, the crest coming about where the line is drawn across the gorge in the view. Work is now going on upon the railroad to the site, the diversion tunnel around the dam is about completed and the diversion dam will be finished this year so that construction of the main dam should be started next season.

## New Building Board Goes into Effect in New York

Under a new law a board of review of the building operations in all five boroughs of New York City has just been formed. This board, known as the Board of Standards and Appeals, is headed by Rudolph P. Miller, who has been connected with the building department of the Borough of Manhattan for many years. The other members are noted in the "Personals" column of this issue. Mr. Miller has made the following brief memorandum of the duties of the Board.

The new Board of Standards and Appeals is a sort of clearing house for the orders, decisions and interpretations, sometimes conflicting, of the different city departments that have jurisdiction over building construction and occupancy. The jurisdiction of the board covers the testing of materials; the approval of new materials and methods of construction; the making of rules and regulations, supplementing, where necessary, the existing provisions of law, not only with respect to building construction, but also with respect to fire prevention, means of exit, elevator installation, and plumbing and drainage; the hearing of petitions for variations of the provisions of the labor law, and the hearing of appeals from any order, requirement, decision or determination made by a superintendent of buildings or fire commissioner so far as they relate to the construction, alteration, equipment, occupancy or use of any building. An exception, however, is made in the case of tenement houses; no appeal can be had from any provision of the tenement house law and the tenement house commissioner remains supreme in the matter of interpreting that law. So far as the labor law is concerned the Board's jurisdiction starts at once; in respect to the other matters, it's jurisdiction is not effective until Oct. 1, 1916, when the present Board of Examiners will go out of existence.

**A Projected Railway in Salvador,** which will make through rail travel possible from the United States to Granada, Nicaragua, is projected by the International Railways of Central America, of 17 Battery Place, New York City, a corporation affiliated with the United Fruit Co. As described in a paper by F. W. Blackford at the annual meeting of the Montana Society of Engineers, the company owns and operates in Guatemala and Salvador 521 mi. of single-track narrow-gage railways and has projected extensions of 323 mi. Work on these projected lines was partially suspended soon after the beginning of the war on account of the difficulty of financing. Only 84 mi. of the railways now in operation are in Salvador. This country has an area of 7,325 sq.mi., with a population averaging 232 per sq.mi., or as dense as that of the State of Connecticut. The country is extremely rugged and much of it is volcanic, so that the difficulties of railway construction are great. The maximum grade adopted on the surveys of the new lines are 2%, with a compensation of 0.04 per degree of curvature. The maximum curve was 16°. The country is subject to torrential rains. During the locating surveys on Oct. 26, 1913, 12 in. of rain fell between 4 a.m., and 4 p.m. The rain was general over Salvador and in places reached 14 in. in the 12 hr.

# News of the Engineering World

## Big Storage Reservoirs in North Carolina

Contracts have just been let by the Southern Power Co., of Charlotte, N. C., for three large earth dams near Bridgewater, N. C., the cost aggregating about $2,000,000. The successful bidders were Rinehart and Dennis, of Charlottesville, Va., and the Hardaway Contracting Co., of Columbus, Ga. The contract was awarded jointly.

All three dams will be of earth. The construction plans involve dumping off trestles within the slope lines and washing to the center with high-pressure streams of water. The slopes are to be 2 on 1 and the top widths 60 ft. The largest dam is to be on the Catawba River and is 2,800 ft. long by 135 ft. high. The second one will be on Paddy's Creek and is to be 1,500 ft. long by 155 ft. high. The third is to be on Linville River and 1,100 ft. long by 150 ft. high. There will be concrete spillways and tunnel linings. At Linville two 7,000-kw. generating units will use water released to reservoirs below. The work includes 4,500,000 cu.yd. of main excavation, 50,000 cu.yd. of concrete, 40,000 yd. of tunnel excavation and 100,000 yd. of rip-rap. Ten steam-shovel outfits will be employed and a large concreting plant.

## Two New Railway Chief Engineers

The portraits of the new chief engineers of two Eastern railways are shown herewith. The appointment of R. N. Begien as chief engineer of the Baltimore & Ohio R.R. was noted in *Engineering News*, July 6, p. 42, together with a brief biographical sketch. A. E. Owen's appointment as chief engineer of the Central R.R. of New Jersey was noted in the personal columns of last week.

RALPH NORMAN BEGIEN

Mr. Owen was born in Montclair, N. J., Jan. 19, 1876. He studied engineering at Rutger's College, New Brunswick, N. J., and began his experience in railway work as a draftsman in the office of the tax agent of the Central R.R. of New Jersey at New York City in 1898. The following year he was transferred to the office of the chief engineer. Subsequently he was assistant engineer of the railway at Mauch Chunk, Penn., and at Jersey City, N. J. In 1907 he was promoted to be principal assistant engineer.

ARTHUR E. OWEN

## Minnesota Steel Company's New Plant at Duluth

Ever since the development of the enormous iron-ore deposits lying to the north of Duluth, Minn., projects have been agitated to convert the ore into finished iron and steel at this location, instead of transporting the ore nearly a thousand miles by water and a hundred miles by rail to the furnaces of the Pittsburgh district. At present most of the big ore-carrying vessels have to make their return trips empty. By establishing furnace plants at the head of the Lakes, it would be possible to bring the coal to the ore as well as the ore to the coal, and effect this transportation at comparatively low cost.

The United States Steel Corporation, after the completion of its great plant at Gary, Ind., some years ago,

undertook the development of steel manufacture at Duluth. A tract of 1,500 acres was purchased at the head of Duluth harbor, about nine miles from the center of Duluth but within its corporate limits. On this site there has been completed within the present year a steel-manufacturing plant involving the investment of some $20,000,000. There are two 500-ton blast furnaces and ten open-hearth steel furnaces of 75-tons capacity each. The rolling mills in connection with the plant are equipped to turn out steel rails, structural shapes, or merchant bars. The ingots produced are 22x26x77 in., and are handled in a 40-in. reversing blooming mill, the exhaust steam from which is utilized by a low-pressure steam-turbine electric-generator unit. The gas from the furnaces is utilized in four twin-tandem gas-engine generator sets of 3,000-kw. capacity and five single-tandem gas-blowing engines of 24,000-cu.ft. capacity each. The coal brought by the Lake steamers is converted into coke in 90 Koppers byproduct coke ovens, so that the plant has the gas from these ovens available for use as well as the gas from the blast furnaces. The buildings of the plant are of steel frame construction with walls made up of two-piece concrete blocks.

Slag from the blast furnaces is delivered to four slag-granulating pits, and is then utilized for the manufacture of portland cement in a 4,000-bbl. cement-making plant owned by the Universal Cement Co. Nearly 2,500 employees will be required for the complete operation of the steel plant and cement plant, and the steel plant can produce 350,000 tons of steel per annum.

## Engineering Students Number Over Thirty Thousand

The appended tabulated figures on students in the engineering schools of the United States were presented at the recent annual meeting of the Society for the Promotion of Engineering Education, through the coöperation of the United States Bureau of Education and the society's Committee on Statistics. A variety of interesting comparisons are possible, such as the great increase in chemical engineers, the decrease in civil and mining, and the slump and recovery in number of mechanical engineers.

STUDENTS IN THE UNITED STATES

| Engineering Branch | 1906 | 1911 | 1915 |
|---|---|---|---|
| General | 2,501 | 5,591 | 6,059 |
| Chemical | 1,234 | 1,452 | 2,383 |
| Civil | 7,962 | 8,934 | 7,182 |
| Electrical | 5,696 | 6,128 | 6,637 |
| Mechanical | 7,426 | 7,052 | 7,751 |
| Mining | 2,826 | 2,337 | 1,922 |
| Other | 82 | .... | 958 |
| Total | 27,727 | 31,499 | 32,843 |

## Straightening Root River for Land Reclamation

A contract for straightening Root River, Houston County, Minnesota, so as to substitute 20.7 mi. of river channel for 31.3 mi. and reclaim 11,765 acres of land subject to overflow three years out of five on the average, has just been awarded on bids received June 3, 1916, to R. H. & G. A. McWilliams, of Chicago, at 6.69c. per cu.yd. of excavation. The work includes 1,825,451 cu.yd. of excavation, clearing 50 acres of right-of-way, and removing and replacing two highway bridges, to be done by Dec. 31, 1918. Contracts for a new railroad bridge and a second highway bridge were not let.

The new channel begins 3 mi. west of Houston and joins the old channel 2 mi. west of the junction of the Root with the Mississippi, about 3 mi. below La Crosse. The bottom of the new channel will be 50 ft. at its upper end, increasing to 72 ft. at a point 3½ mi. above its lower end. The side slopes will be 1 to 1. The fall in its 20.7 mi. of length will be 55 ft. At flood stage the computed velocity is 6 ft. per sec. and the discharge 7,000 sec.-ft. The land reclaimed has an estimated value of $150 an acre. The court has assessed a benefit of $11.50 an acre on the land. The report on the ditch, known as Judicial Ditch No. 1, Houston County, was made by George A. Ralph, Chief Engineer.

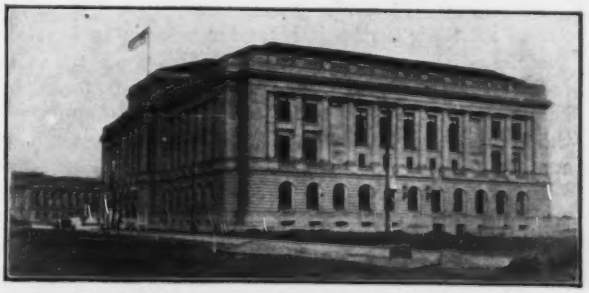
## Supervising Architect's Office May Be Superseded

The House of Representatives has just reported the Public Buildings Bill, with a radical provision which changes the present system of conducting federal building work and abolishes, as such, the office of the Supervising Architect. In its stead the bill creates a Bureau of Public Buildings, headed by a Commissioner of Public Buildings to be appointed by the President and to hold office for four years.

The Bureau of Public Buildings will have complete jurisdiction over and control of the selection of sites, drafting of plans and specifications, supervision of construction and care and maintenance of all public buildings. It is provided that as far as possible the officers and employees of the office of the Supervising Architect are to be transferred to the new Bureau. The bill provides for the standardization of buildings in the smaller places and makes such restrictions as to the purchase of sites and construction of buildings as will result in saving of 25 to 50% over previous authorizations.

## Cleveland's New City Hall and Civic Center

The new City Hall of Cleveland, Ohio, was dedicated with appropriate ceremonies on July 4. The site for the building was selected by a commission in 1898, and this commission worked out at the same time a plan for grouping the principal public buildings of the city. The architect of the City Hall was J. Milton Dyer. The building covers an area 230x380 ft., is five stories high with a basement and sub-basement, and cost about $3,000,000. The structure is of steel framework and reinforced concrete. The exterior walls are of Vermont gray granite,



NEW CITY HALL AT CLEVELAND, OHIO

and Italian marble is profusely used for the interior finish. The architecture of the building was planned to harmonize with the Federal Building, which was the first of the group plan to be erected. The second building of the group completed was the County Court House, which is seen in the background in the accompanying view of the new City Hall. These buildings are located at the top of a bluff overlooking Lake Erie.

The other three buildings which will complete the group plan are a $2,000,000 public library building, which is to be built on a site just across the street from the Federal Building, a Union Station and a Convention Hall. An agreement between the railroad and the city for the new Union Railway Station was ratified by popular vote last November. Work on the construction of the building awaits action by Congress, authorizing the sale of the Marine Hospital grounds, which are part of the site. The bill has passed the Senate and is now before the House. Bonds were voted for the Convention Hall last April. The total cost of these six public buildings will be about $30,000,000.

## Floods Make Havoc in the South

Heavy floods in North and South Carolina, Virginia, Tennessee and West Virginia, on July 15 and 16, caused property damage of some $15,000,000 and the loss of upward of 15 lives. Railroad and telegraph communication has been seriously interrupted and details of engineering work affected are not obtainable.

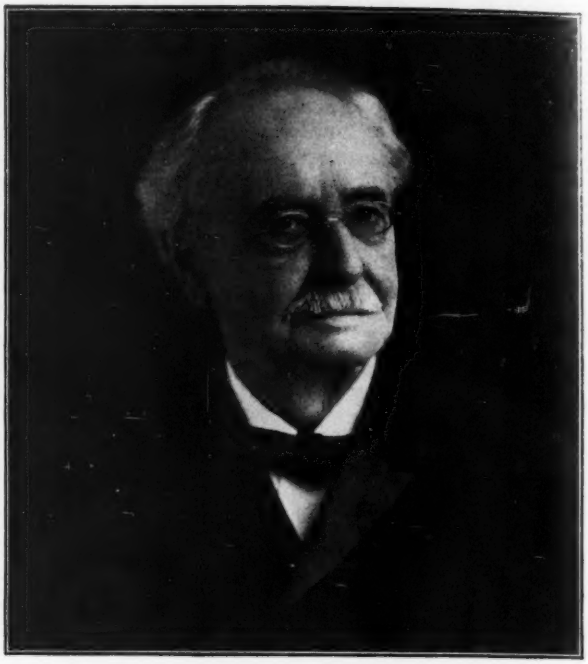
A small dam and power station of the Dravo Power Co. on the Broad River near Gaffney, S. C., was washed out. An earth fill at the Lookout dam near Statesville, N. C., broke and destroyed an old mill in which cotton was stored. Dams of the Southern Power Co., at Lake Toxaway and Hendersonville were reported out but this has been denied by the company. The hydro-electric power stations of this company at Lookout Shoals, Catawba, Ninety-Nine Islands, and the steam station at Mt. Holly were partly submerged.

Many railroad and highway bridges were lost, including one under construction by the Southern Ry. over the Catawba River at Belmont, N. C.; there were 14 men at work of whom four were reported rescued. The greatest loss reported in any one place was at Asheville, N. C., where 25 cotton and lumber mills, machine shops, coal yards, etc., and 60 dwellings were washed away. About 1,200 persons were thrown out of work and 400 made homeless.

## Don Juan Whittemore

Don Juan Whittemore, oldest past-president of the American Society of Civil Engineers and an honorary member of the Society since 1911, died July 16, at his home in Milwaukee, Wis. He was 86 years old, but he had retired from active work, as chief engineer of the Chicago, Milwaukee & St. Paul Ry., only six years ago.

In years of service in railway engineering he had had perhaps no equal. He was born at Milton, Vt., in 1830, and entered the engineer corps of the Vermont & Canada R.R. when but 17 years of age. Within two years he was assistant to the chief engineer of the road and in charge of a construction division.



DON JUAN WHITTEMORE

On the completion of the Vermont & Canada R.R. young Mr. Whittemore was appointed Assistant Engineer in charge of a division of the Great Western Ry. of Canada, where he remained until 1852. He then served as engineer for the contractor in the building of the Central Ohio R.R. from Zanesville to Wheeling, W. Va. For the four years following 1853 he was assistant to the chief engineer of the La Crosse & Milwaukee R.R.; then chief engineer of the Southern Minnesota R.R.

During the winter of 1860-61 he was in Cuba as chief assistant engineer of the Ferrocarril Del Oeste. In the spring of 1861 he returned to Wisconsin to become chief assistant engineer of the La Crosse & Milwaukee R.R., the nucleus of the Chicago, Milwaukee & St. Paul Ry., of which Mr. Whittemore was made the first chief engineer in 1863, and of which he remained chief engineer for 47 years. Upon his retirement as chief engineer in December, 1910, the honorary position of consulting engineer of the railway was created for him.

During his long career as a railway chief engineer Mr. Whittemore received many honors. He was elected president of the American Society of Civil Engineers in 1884. The following year he was made a member of the Institution of Civil Engineers of Great Britain. He received the honorary degrees of Doctor of Laws and Doctor of Philosophy from the University of Wisconsin and the degree of Civil Engineer from the University of Vermont. He was also an honorary member of the Western Society of Engineers.

**Plans for an Activated-Sludge** plant to treat the sewage of Matawan, N. J., drawn by Geo. A. Johnson, Consulting Engineer, New York City, has been approved by the State Department of Health.

**A Collapse of Subway Timbering** occurred on Nostrand Ave., Brooklyn, on July 13. Following a heavy rain, a large sewer broke, the water washing out sufficient supports to cause the collapse of 200 ft. of roadway, including the surface tracks of the Brooklyn Rapid Transit Co. An approaching trolley car disregarded a warning and fell into the hole, six persons being injured.

**Notable Philippine Railway Completed**—The railway from Manila to Hondagua, across the Island of Luzon from west to east has been completed and thrown open to traffic. This provides rail connection between Manila, which is on the west coast, on the China Sea, with the Pacific coast ports on Lopez Bay, where direct service may be established with American ports, shortening the route to Manila by several days. The railway is through primeval tropical forests and has been four years building.

**A Large Amount of Paving in Cleveland, Ohio,** is projected but must await popular authorization at an election called for Aug. 8. The general scheme adopted by the City Council calls for a bond issue of $3,500,000 for the extension of 107 streets. Other paving propositions in hand would bring the total bond issue up to $6,500,000. Since for every dollar provided by the city nearly as much is forthcoming from property owners, about $11,500,000 will be expended in street extensions and repaving in Cleveland, if the two schemes go through.

**A Public Buildings Commission** to investigate as to what public buildings are needed in the District of Columbia to provide accommodations for all the Federal offices there, with the proper location of such buildings, and their probable cost, is provided for in the Sundry Civil Appropriation Bill approved July 1. The Commission is to be composed of members selected from the committees on Appropriations and on Public Buildings of the House and the Senate, together with the Superintendent of the Capitol Building, the officer in charge of public buildings and grounds and the Supervising Architect. The report of the Commission is to be made not later than Jan. 1, 1918.

**Openings for Highway Engineers** are made by the passage of the Federal Aid Road Act, noted in last week's issue. The Office of Public Roads and Rural Engineering under Logan Waller Page is already seeking experienced highway engineers. An examination is announced, Aug. 8, for Senior Highway Engineers, at salaries from $2,200 to $4,000 per annum. The competitors will not be assembled for a written examination but will be rated on training and experience. Applicants must be at least 30 years old and have had eight years "responsible engineering experience" not less than five of which must have been in "responsible highway engineering." Applications should be addressed to the Civil Service Commission at Washington.

**St. Louis Garbage Collectors' Strike Ended**—There were no garbage collections in the city of St. Louis from June 30 to July 6. The white teamsters employed by the street-cleaning and some other city departments struck for an increase in pay of from $50 to $65 per month. The negro teamsters, who were practically all on garbage collection, did not strike, but they were intimidated and refused to take out the teams. The strike was finally settled by an agreement of the Board of Estimate (which is composed of the Mayor, President of the Board of Aldermen and the Comptroller) to increase the salaries as demanded. The Comptroller voted against the increase on the ground that it is the entering wedge for a raid by union laborers on the city treasury.

**Bayonne, N. J., Five Days Without Water-Supply**—Owing to a break in the water-supply main near where it passed under the tracks of the Delaware, Lackawanna & Western R.R. in the Hackensack meadows, the City of Bayonne, having a population of about 68,000, was practically without water for five days. The water-supply of the city is furnished by the New York & New Jersey Water Co., which in turn purchases the water from the Passaic Water Co. The break is said to have been caused by the vibration of passing trains, and owing to the swamp land through which the pipe is laid, there was much delay in getting at the break. Several pumps of large capacity were required to unwater the hole. A partial supply of water was obtained by a connection with Jersey City mains.

**A Section of the Groined Arch** concrete roof of the clear-water basin of the new West Side water filters at Cleveland, Ohio, collapsed on the night of July 9. No one was hurt. The roof was carried on 20-in. square columns spaced on 15 ft. 9 in. squares and reinforced with four ¾-in. vertical round rods, bound with ¼-in. wire every 24 in. The groined arches were 6 in. thick at crown, about 12 in. thick at spring and reinforced with ¼-in. square rods. The columns averaged 22 ft. 6 in. in height. At the time of the collapse none of the gravel or earth fill had been placed on the roof. The failure is complete over an area about 30 ft. square and involves four columns. An official investigation is now under way.

**The National Septic Process Protective League,** an organization of municipalities and others to coöperate in defending suits for infringements of the Cameron septic tank patents, announces in a circular dated July 6 that over seventy municipalities have already joined the League. H. M. Bracken, of the Minnesota State Board of Health, is President; A. Elliott Kimberly, Consulting Engineer of Columbus, Ohio, is Vice-President, and Frank G. Pierce, Secretary of the League of Iowa Municipalities, Marshalltown, Iowa, is Secretary-Treasurer. The organization of the League was noted in "Engineering News" of Mar. 23, 1916, p. 578. The circular states that "if the present claims of the Cameron Septic Tank Co. are established in court, every sewage-disposal plant in the country that has not settled with this company will be liable for a royalty. On the contrary, if the court of last resort once holds against the company, every municipality is thereby freed from payment of royalty." The League invites the coöperation of other engineers and municipalities not already members.

**The Moffatt Tunnel,** projected through the transcontinental divide, on the line of the Denver & Salt Lake City R.R., may be financed by a combination of Eastern and Denver capital. Denver newspapers state that a syndicate of Boston and New York banking houses has agreed to subscribe $3,000,000 provided an additional $3,000,000 is raised in Denver. Of the latter amount, $1,000,000 has been subscribed by a syndicate of Denver capitalists and an association of Denver banks and trust companies has agreed to take a second million, leaving one million to be subscribed by small investors. The Denver & Salt Lake Ry., originally the Denver, Northwestern & Pacific Ry., was projected and built by the late D. H. Moffatt, and is planned eventually to reach Salt Lake City. As originally built, the railway crosses the divide at an elevation of about 11,700 ft., and the steep grades and curvature on the summit division of the road add greatly to its operating expenses, while the winter operating conditions are very severe. By driving a tunnel about 5½ mi. long through the ridge the summit elevation would be lowered about 1,700 ft. Numerous attempts have been made in the past ten years to finance the tunnel project through the aid of the State of Colorado or the City of Denver, but they have all been defeated.

**The Water-Works of Chattanooga, Tenn.,** owned by the City Water Co., have been valued by a board of three appraisers appointed under an agreement between the company and the city. The board consisted of J. N. Hazlehurst, of Atlanta, William Wheeler, of Boston, and John W. Alvord, of Chicago. The members of the board disagreed as to the method of computing depreciation on the plant. After agreeing substantially on the cost of reproduction, Messrs. Wheeler and Alvord, adopting the sinking-fund method of estimating depreciation, arrived at a total of $398,675 as the amount to be deducted. Mr. Hazlehurst, in a minority report, used the straight-line method of depreciation, and obtained a figure of $743,159. The final estimate of Mr. Hazlehurst for the total value of the property is $2,000,000. In justification of the fairness of this estimate, Mr. Hazlehurst shows that the city, in case it decided not to purchase the company's plant, could build an entirely new plant by the investment of $2,000,000, which could be operated at an estimated cost of $77 per 1,000,000 gal. furnished, which compares with $104 operating cost by the present plant. Mr. Hazlehurst further shows that the actual money invested by the company in the plant after deducting its profits through the sale of lands is $1,544,000. The water rates it has collected have paid its operating charges, taxes and interest on the investment, so that if the city paid the company $2,000,000 it would be allowing a profit of $456,000 on the company's investment over and above what it has received in interest.

**A Bridge Across San Francisco Bay** between Oakland and San Francisco is projected by the "Associated Bridge Engineers," made up of Wilbur J. Watson & Co., of Cleveland; William Russell Davis, of Albany, N. Y.; and Harlan D. Miller, of Albany, N. Y., and Oakland, Calif. The bridge would cross the bay at its narrowest part and its terminal in San Francisco would be south of nearly all of the main docks for seagoing steamers, so that ocean traffic would not be much interfered with. The bridge as designed would carry four railway tracks, two for through railway trains and two for interurban trains, and three roadways, one for automobile traffic and two on brackets outside the trusses for slow-moving traffic. The total width of the bay at the crossing is about three miles, and with its approaches the bridge would be about five miles in length. The designs are based upon a structure made up chiefly of 250-ft. steel truss spans supported on concrete cylinder piers with pile foundations. Over the deep-water channel in the bay there would be a 600-ft. span 100 ft. above the water, and in addition a lift span which could be raised to give 210 ft. vertical clearance to high-masted vessels. Similar spans would be located where the bridge crosses the Oakland estuary, the channel by which vessels reach the piers at Oakland. A public hearing on the plans

for the bridge is to be held in San Francisco Aug. 15 and at Oakland on Aug. 7, before a Board of United States Army Engineers, consisting of Col. Thomas H. Rees, Col. Charles L. Potter and Maj. George B. Pillsbury.

**The Sundry Civil Appropriation Bill** which became law on July 1 provides $7,267,000 for the continuation of work on public buildings previously authorized. The only large items in this are for the Post Office and Court House at Portland, Ore., $425,000, and for the new Interior Department Building in Washington, $756,000. The Public Health Service receives $2,058,000, and in addition special appropriations of $400,000 for the prevention of epidemics, $250,000 "for field investigations of the diseases of man and conditions influencing the spread thereof, including the sanitation and sewage and pollution of navigable streams and lakes of the United States"; and $25,000 for special studies of rural sanitation. The Interstate Commerce Commission, in addition to its regular appropropriation, receives $225,000 to enable it to keep informed regarding safety conditions on railways and to investigate and test block signals, train control and other safety appliances. To carry on the work of railway valuation, $3,500,000 was appropriated. The War Department receives $4,683,000 for improvements and other work at arsenals and munition factories. In this is included $500,000 for a new Government powder plant, $500,000 for increasing the capacity of the Rock Island arsenal, and $800,000 for the Watervliet arsenal. The Engineer Department receives $700,000 for continuing the work on the Lincoln Memorial and the rebuilding of the Aqueduct Bridge across the Potomac River in Washington is authorized, the contract price not to exceed $900,000. For the Interior Department, $700,000 is appropriated for public land surveys, with the compensation of surveyors limited to $200 per month, except in Alaska, where the limit is $10 per day and not to exceed $3 per day for subsistence. The U. S. Geological Survey receives $1,255,000, the Bureau of Mines $955,000, and the Reclamation Service $8,884,000. The Alaska Engineering Commission, for its work in building the Government railway in Alaska, receives $6,250,000. The Coast and Geodetic Survey receives $425,000 for field expenses, $330,000 for its marine equipment, $275,000 for office expenses. For the operation and maintenance of the Panama Canal, $15,800,000 is appropriated; and in addition, $4,535,000 for fortifications, barracks, etc.

## PERSONALS

**F. H. Chamberlain** has resigned as General Manager of the Alabama Power Co., Birmingham, Ala.

**S. A. Arnold** and **B. A. Tripp** have opened offices in Cleveland, Ohio, under the firm name of Arnold & Tripp, for the practice of landscape architecture.

**Henry L. Bowlby,** former State Highway Engineer of Oregon, is now Executive Officer of the Pacific Highway Association with headquarters at Portland, Ore.

**F. A. Burr** has resigned as General Sales Manager of the Tennessee Coal, Iron and Railroad Co. to accept a similar position with the Etna Explosives Co., New York City.

**Allen Loomis,** of the engineering staff of the Packard Motor Car Co., Detroit, Mich., has resigned to engage in private practice as a consulting engineer, with offices in Cleveland, Ohio.

**H. B. McMaster,** General Manager of Branches of the Berger Manufacturing Co., Canton, Ohio, has resigned to become Vice-President and General Manager of the Gordon Tire and Rubber Co., Canton.

**E. J. Burdick** has been appointed Assistant General Manager of the Detroit United Ry. He has been with the Detroit street railway since 1895, and is a past-president of the Detroit Engineering Society.

**A. N. Talbot,** M. Am. Soc. C. E., Professor of Municipal and Sanitary Engineering at the University of Illinois, has been awarded an honorary degree of Doctor of Engineering by the University of Michigan.

**Edward I. Clawiter,** Assoc. M. Am. Soc. C. E., has resigned as Engineer in charge of the southern division of Miller & Lux, Inc., to become Engineer of the San Francisco Bridge Co., San Francisco, Calif.

**Willis Whited,** M. Am. Soc. C. E., Bridge Engineer of the Pennsylvania State Highway Department, received the honorary degree of Doctor of Engineering at Iowa State College at the recent commencement.

**Rodman Wiley,** Assoc. M. Am. Soc. C. E., Bridge Engineer of the Kentucky State Highway Department, has been appointed Road Commissioner to succeed Robert C. Terrell. The salary of the office is $3,000 per annum.

**R. L. Heeren,** formerly a civil engineer, Bridge and Construction Department of the Pennsylvania Steel Co., Steelton, Penn., has joined the engineering and sales department of the Bethlehem Steel Co., South Bethlehem, Penn.

**J. F. Putnam,** Assoc. Am. Inst. E. E., has been appointed Assistant Professor of Electrical Engineering at Sibley College, Cornell University. He was formerly Professor of Physics at St. Johns College, Shanghai, China.

**Richard M. Kreutz,** formerly a civil engineer, Bridge and Construction Department of the Pennsylvania Steel Co., Steelton, Penn., is now with the sales and engineering department, Bethlehem Steel Co., South Bethlehem, Penn.

**Robert Farnham,** M. Am. Soc. C. E., recently Assistant to the Engineer of Bridges and Buildings of the Pennsylvania R.R., has been appointed Assistant Engineer of Bridges and Buildings, and his former position has been abolished.

**W. J. Collier,** of Harrisburg, Penn., has been appointed Plant Engineer of the Steelton plant of the Bethlehem Steel Co., formerly the Pennsylvania Steel Co. He is a graduate in civil engineering of Lehigh University, class of 1895.

**William G. Arn,** Assoc. M. Am. Soc. C. E., recently Roadmaster of the Illinois Central R.R. at Mattoon, Ill., has been promoted to be Assistant Engineer of Maintenance-of-Way, with office at Chicago, Ill., succeeding Milton B. Morgan, transferred.

**A. W. Thompson,** M. Am. Soc. C. E., has been appointed Vice-President in charge of traffic and commercial development of the Baltimore & Ohio R.R. system. He is a former Chief Engineer of the railway, and since 1912 has been Vice-President in charge of operation.

**C. F. Hinchman,** Assistant Engineer of Maintenance-of-Way of the Cleveland, Cincinnati, Chicago & St. Louis R.R. at Mount Carmel, Ill., has been promoted to be Engineer of Maintenance-of-Way, Indianapolis terminal division, Indianapolis, Ind.

**J. G. Bloom,** M. Am. Soc. C. E., recently Division Engineer of the Chicago, Rock Island & Pacific Ry. at Little Rock, Ark., formerly with the valuation department of the railway at Chicago, has been promoted to be Division Superintendent of the Amarillo division, with headquarters at Amarillo, Tex.

**W. Kemp Walker,** Assoc. M. Am. Soc. C. E., has resigned his position of Assistant Field Engineer, Roadway Department, Division of Valuation, Interstate Commerce Commission, with headquarters at Kansas City, Mo., to become Engineer in charge of special track work of the Wabash R.R., with offices at Peru, Ind.

**J. H. Myers,** Assoc. M. Am. Soc. C. E., recently with the Bridge and Construction Department of the Pennsylvania Steel Co., Steelton, Penn., has been promoted to be Assistant Superintendent of the plant, which is now a part of the Bethlehem Steel Co. Mr. Myers is a graduate of Lehigh University in civil engineering, class of 1896.

**Henry G. Stott,** M. Am. Soc. M. E., Superintendent of Motive Power of the Interborough Rapid Transit Co., of New York City, was obliged to undergo a very serious operation on Friday, July 7, in connection with a trouble of long standing. Mr. Stott has improved since the operation, and his present condition promises a speedy recovery.

**A. D. Ludlow,** a sewer contractor of Kansas City, Mo., has been appointed Engineer of Sewers, Department of Engineering of Kansas City. He is a former Assistant Engineer of the city engineering department and was Assistant Engineer of the Kansas City Terminal Ry. during the construction of the Kansas City Union Station.

**John J. Bernet,** Vice-President of the New York Central Lines, Chicago, Ill., has been elected President of the reorganized New York, Chicago & St. Louis R.R. (Nickel Plate), which was recently sold by the New York Central Lines to Cleveland, Ohio, capitalists. Mr. Bernet is 48 years old; he entered the railway service in 1889 as a telegraph operator on the Lake Shore & Michigan Southern Ry.

**R. L. Daugherty,** for the past six years Assistant Professor of Hydraulics at Sibley College, Cornell University, has been appointed Professor of Hydraulic Engineering at Rensselaer Polytechnic Institute, Troy, N. Y. He succeeds Prof. Lewis F. Moody, who has resigned to engage in private practice. Professor Daugherty graduated from Leland Stanford University in 1909. He is the author of three textbooks, "Hydraulic Turbines," "Centrifugal Pumps" and "Hydraulics."

**Frank G. White,** Assoc. M. Am. Soc. C. E., Chief Assistant Engineer of the California State Board of Harbor Commissioners, has been appointed Chief Engineer of the Board to succeed Jerome Newman, M. Am. Soc. C. E., resigned, as noted in these columns July 6. Mr. White is a graduate of

the University of Iowa, and for the past six years has been Chief Assistant Engineer of the Harbor Commission. Before that he was with the City Engineer's department of San Francisco, being employed on the design of several of the large sewers.

**H. H. Rousseau,** Assoc. M. Am. Soc. C. E., Civil Engineer U. S. N., who has been a member of the Isthmian Canal Commission since 1907, has been ordered home and placed on waiting orders. Mr. Rousseau was made Chief of the Bureau of Yards and Docks in January, 1907, and three months later resigned to accept the Panama appointment. Since that time he has been resident on the Isthmus and for the most part in charge of building and terminal construction. Under an Act of Congress, Mar. 4, 1915, he was advanced to the grade of Civil Engineer in the Navy, with the rank of Rear-Admiral of the lower nine.

**Robert C. Terrell** has been removed as State Road Commissioner of Kentucky. The following extract from an editorial in the Paducah "Evening Sun" of June 30 is of interest as a local view of the situation:

In view of the fact that Terrell has always rendered satisfaction it will doubtless strike the people of the state as peculiar that he was not retained in his position. The only possible anwer is that the governor does not see in Terrell the combination of a good servant and an able politician. The ex-road commissioner has never been much of a factor in politics. He has committed the unpardonable sin of attending to the business of his department, and unwisely refrained from getting out and participating in the election of state officials, which is almost as bad in Frankfort's official eye as working for the other side.

**Rudolph P. Miller,** M. Am. Soc. C. E., former Superintendent of the Bureau of Buildings, Borough of Manhattan, New York City, has been appointed Chairman of the newly created Board of Standards and Appeals, which will have jurisdiction over all building operations in all the five boroughs of the city, instead of the control being separate for each borough. The new Board has but two salaried members, the Chairman and Daniel Sullivan, Secretary. Mr. Miller's salary is $7,500 per annum and the Secretary's $3,600. Other members of the Board are L. C. Holden, Architect; William Crawford, Building Contractor; Howard C. Baird, M. Am. Soc. C. E., of the firm of Boller, Hodge & Baird, Consulting Engineers; A. R. Kirkus, a real estate expert, and A. J. Boulton, a Brooklyn labor representative, who receive $10 a day whenever the Board convenes.

**William Wallace Ewing,** M. Am. Soc. C. E., has been appointed Special Agent of the Bureau of Foreign and Domestic Commerce of the United States Department of Commerce. His work will be to investigate construction materials and machinery in South America. Civil-service examinations for the position were held in 25 cities and 19 men took the examination. About two-thirds of these passed the examination and in turn were requested to present themselves in Washington for an oral examination before the appointment committee. Mr. Ewing was successful in both examinations and will shortly commence his duties at the Bureau in Washington. After an extended trip in the United States in conference with the exporters, receiving their specifications and other information for presentation in the foreign field, a tour of South America will be made visiting all of the principal centers, where engineering and construction materials and equipment are used. Progress reports will be made during this period. On return to the United States it is planned to revisit the exporters, advising and conferring with them regarding the best methods to be used in developing the sale of their several manufactures.

## OBITUARY

**Richard H. McCary,** President of the R. H. McCary Co., general contractors, Los Angeles, Calif., died June 26.

**James L. Brass,** Assistant General Manager of the Union Pacific R.R. system died June 30, at Seattle, Wash. His early experience was with the auditing department of the maintenance-of-way division of the Oregon-Washington Railroad and Navigation Co.

**Daniel Edmund Garrison,** a retired steel manufacturer of St. Louis, Mo., died July 4. As President and General Manager of the Vulcan Steel Co., he is said to have rolled the first steel rails in the country west of the Mississippi River. He was 77 years old and retired from active business in 1890.

**James Frank Morrison,** a pioneer electrical engineer, first President of the National Electric Light Association, died July 3, at his home in Baltimore, Md. He was born at St. John, N. B., in 1841. He was a telegraph operator with the Baltimore & Ohio R.R. during the Civil War period. Subsequently he was with the Western Union Telegraph Co. at Baltimore. In 1870 he was made Superintendent of the fire-alarm and police telegraph systems of Baltimore, completely reorganizing them. In 1878 he constructed for the Chesapeake & Ohio Canal Co., what is claimed to be the first long-distance telephone line—210 mi. from Georgetown, V. C., to Cumberland, Md. He was also a pioneer in the electric-lighting industry.

## ENGINEERING SOCIETIES

INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS.
Aug. 29-Sept. 1. Convention in Providence, R. I. Secy., James McFall, Roanoke, Va.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.
Sept. 4-7. Convention in Hot Springs, Va. Asst. Secy., E. A. Baily, 360 Pearl St., Brooklyn, N. Y.

THE TRAVELING ENGINEERS' ASSOCIATION.
Sept. 5-8. Annual meeting in Chicago, Ill. Secy., W. O. Thompson, care General Offices, N. Y. C. R.R., Cleveland, Ohio.

AMERICAN FOUNDRYMEN'S ASSOCIATION.
Week of Sept. 11. Annual meeting in Cleveland, Ohio. Secy., A. O. Backert, 12th and Chestnut St., Cleveland, Ohio.

THE AMERICAN INSTITUTE OF METALS.
Week of Sept. 11. Meeting in Cleveland, Ohio. Secy., W. M. Corse, 106 Morris Ave., Buffalo, N. Y.

NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.
Sept. 11-16. Convention, Minneapolis, Minn. Secy., Fred W. Raven, 417 S. Dearborn St., Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION.
Sept. 12. Convention in Atlantic City. Secy., A. P. Dane, Reading, Mass.

RAILWAY SIGNAL ASSOCIATION.
Sept. 12-14. Convention in Mackinac Island. Secy., C. C. Rosenburg, Myers Building, Bethlehem, Penn.

ILLUMINATING ENGINEERING SOCIETY.
Sept. 18-20. Convention in Philadelphia, Penn. Asst. Secy., C. D. Fawcett, 29 West 39th St., New York, N. Y.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS.
Sept. 18-22. Convention in Chicago. Secy., W. O. Oschmann, Oliver Iron and Steel Co., Pittsburgh, Penn.

THE ROADMASTERS AND MAINTENANCE OF WAY ASSOCIATION OF AMERICA.
Sept. 19-22. Convention in New York City. Secy., P. J. McAndrews.

MICHIGAN GAS ASSOCIATION.
Sept. 21-22. Annual meeting in Detroit, Mich. Secy., Clark R. Graves, Lansing, Mich.

AMERICAN PEAT SOCIETY.
Sept. 21-23. Annual meeting in Washington, D. C. Secy., Julius Bordollo, Kingsbridge, N. Y.

RAILWAY FIRE PROTECTION ASSOCIATION.
Oct. 3-5. Convention in New York City. Secy., C. B. Edwards, Mobile & Ohio R.R., Mobile, Ala.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.
Oct. 9-13. Convention in Newark, N. J. Secy., Charles C. Brown, Indianapolis, Ind.

AMERICAN ELECTRIC RAILWAY ASSOCIATION.
Oct. 9-13. Convention at Atlantic City, N. J. Secy., E. B. Burritt, 8 West 40th St., New York City.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.
Oct. 17-19. Convention in New Orleans. Secy., C. A. Lichty, C. & N. W. Ry., Chicago.

AMERICAN GAS INSTITUTE.
Oct. 17-20. Annual meeting in Chicago. Secy., G. G. Ramsdell, New York, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION.
Oct. 24-27. Convention in Cincinnati, Ohio. Secy., Prof. Selskar M. Gunn, Boston, Mass.

**The American Association of Engineers** has sent out the first annual report of the national treasurer. The total enrollment is 791. The receipts to May 1 were $4,522.34, the disbursements being $4,044.16. The office of the secretary is at 29 So. La Salle St., Chicago. A branch of the association has been formed in Peoria, Ill.

**The Association of Railway Telegraph Superintendents** has elected the following officers for 1916-1917: President, M. H. Clapp, St. Paul, Minn.; vice-presidents, J. F. Caskey and F. T. Wilbur; secretary and treasurer, W. L. Connelly, Gibson, Ind.

**The State Association of Planning Commissions** of Pennsylvania, a permanent organization of Pennsylvania city-planning commissioners, was formed at a meeting at the Capitol, Harrisburg, on July 11. The following officers were elected: President, A. B. Farquhar, York; vice-president, E. S. Herman, Harrisburg; secretary, J. Herman Knisely, chief of the division of Municipal Statistics, Department of Labor and Industry, the Capitol, Harrisburg, and treasurer, John K. Stauffer, Reading. An executive committee, consisting of one member from the planning commission of each of the third-class cities will be appointed by the planning commissions of the various cities. Plans for beautifying cities and problems confronting planning commissions were discussed at the meeting and will be further taken up by the new organization.

# Appliances and Materials

### New Locknut for Bolts

A new locknut has been devised by the Boss Nut Co., of Chicago. The device is shown in the accompanying sketches. The faces of the nut are concave. In applying, the locknut is run up to the holding nut with the fingers; then a wrench is used until the curved surface next to the holding nut is drawn downward and flattened out. Usually a half-turn is sufficient for this. In this position the threads of a locknut

"BOSS" LOCK NUT

are caused to register deeply and firmly into the valley of the bolt thread, and the impinging edges seize the primary nut so tightly as to prevent all three members from rotating in relation to each other. The locknut can be removed only with a wrench.

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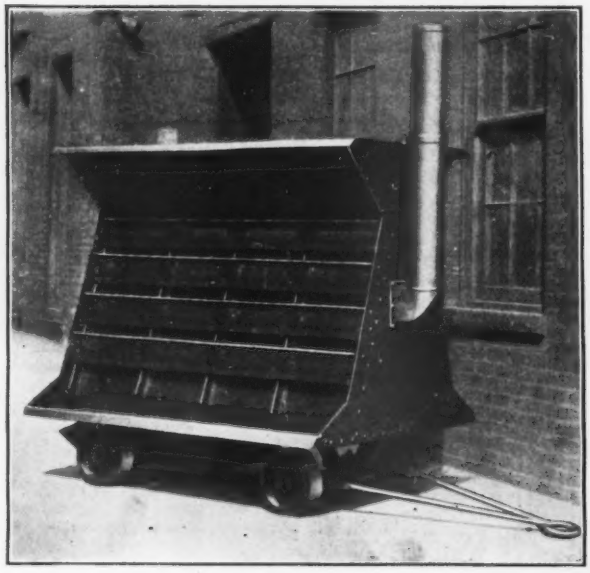
### Gravel Heater and Dryer

A portable device for heating and drying gravel, or grits, particularly for bituminous fillers in block paving work, has been put on the market by Littleford Bros., 453 East Pearl St., Cincinnati, Ohio. The device is the invention of a New York City paving contractor named Mullen, and is known as the Mullen gravel dryer.

The furnace is made of an A-shaped sheet of perforated steel with plain sheet-steel ends, one of which is provided with a fire-door and the other with a smokestack. Outside of the perforated furnace plates are similarly perforated plates or flights, as shown in the accompanying view. These are 3 in. distant from the furnace plates at the bottom and 5 in. at the top.

On top of the A-shaped furnace is a V-shaped hopper with openings into the spaces between the furnace plate and the outside flights, so that the gravel flows down over the furnace plates in a steady stream, so long as the hopper is kept filled.



MULLEN GRAVEL HEATER AND DRYER

One man operates the machine, which it is claimed has a capacity of 4 tons of gravel per hour or 40 tons per 8-hour day. The temperature of the heating can be regulated by the time the gravel is permitted to remain against the furnace plates. The gravel is removed from the bottom of the machine by shoveling.

### Sewage Filter of Vitrified Pipe

A filter for use with the septic tanks of vitrified pipe described in "Engineering News" March 2 and April 27, consists of a 24x30-in. pipe set vertically and fitted with top and bottom. This is partly filled with sand and gravel (or charcoal). The effluent pipe from the septic tank is turned down and buried in this, so that the liquid rises through the filtering medium to reach the outlet on the opposite side of the filter. The filter is not applied when the tank effluent is discharged into sub-irrigation or drainage tile systems. Both the tank and the filter are made by the W. S. Dickey Clay Mfg. Co., of Kansas City, Mo.

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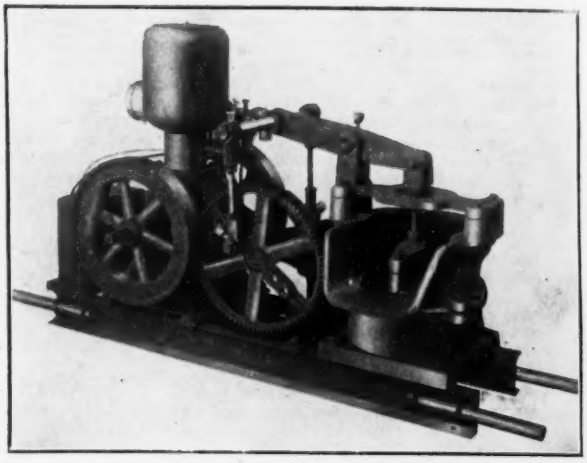
### Power-Driven Diaphragm Pump

A recent design of portable power-operated diaphragm pump, built by the Barnes Manufacturing Co., of Mansfield, Ohio, is shown herewith. The pump, gears and gasoline engine are mounted on a steel frame, and U-bolts on the sills provide for pipe handles by which the outfit can be moved. The engine shaft is connected through gears to a spur wheel carrying a vertical rod attached to a crossbar on the pump beam. A similar rod at the other end of this bar is connected



DIAPHRAGM PUMP WITH GASOLINE ENGINE

to a crank arm on the spur-wheel shaft. The pump has a 3-in. suction hose and can handle sand, gravel and mud. It makes 65 strokes per minute and has a capacity of 4,000 gal. per hr. The engine is of 1½ hp. The complete outfit weighs 500 lb.

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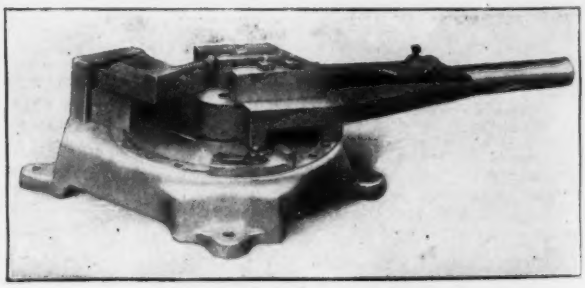
### Bar-Bending Machine

The machine shown herewith is for bending the steel rods and bars used as concrete reinforcement. It is used also for flat bars, etc., and in shop work where it is not desirable to use a press or bulldozer. Besides making ordinary bends it is fitted with special dies for angle, loop, hook and U-bends, and for edgewise bending of flat bars over 2 in. wide. The smallest size, handling cold bars not larger than ½ in., has a



HINMAN BAR-BENDING MACHINE

round, deep base that can be set in a socket in top of a post. In the larger sizes a broad, flat base with anchor bolts is used as shown. The largest size will bend hot and cold flats 1x5 in. and ½x4 in.; and hot and cold bars 2 in. and 1¼ in. respectively. These machines are built by D. A. Hinman & Co., of Sandwich, Ill.